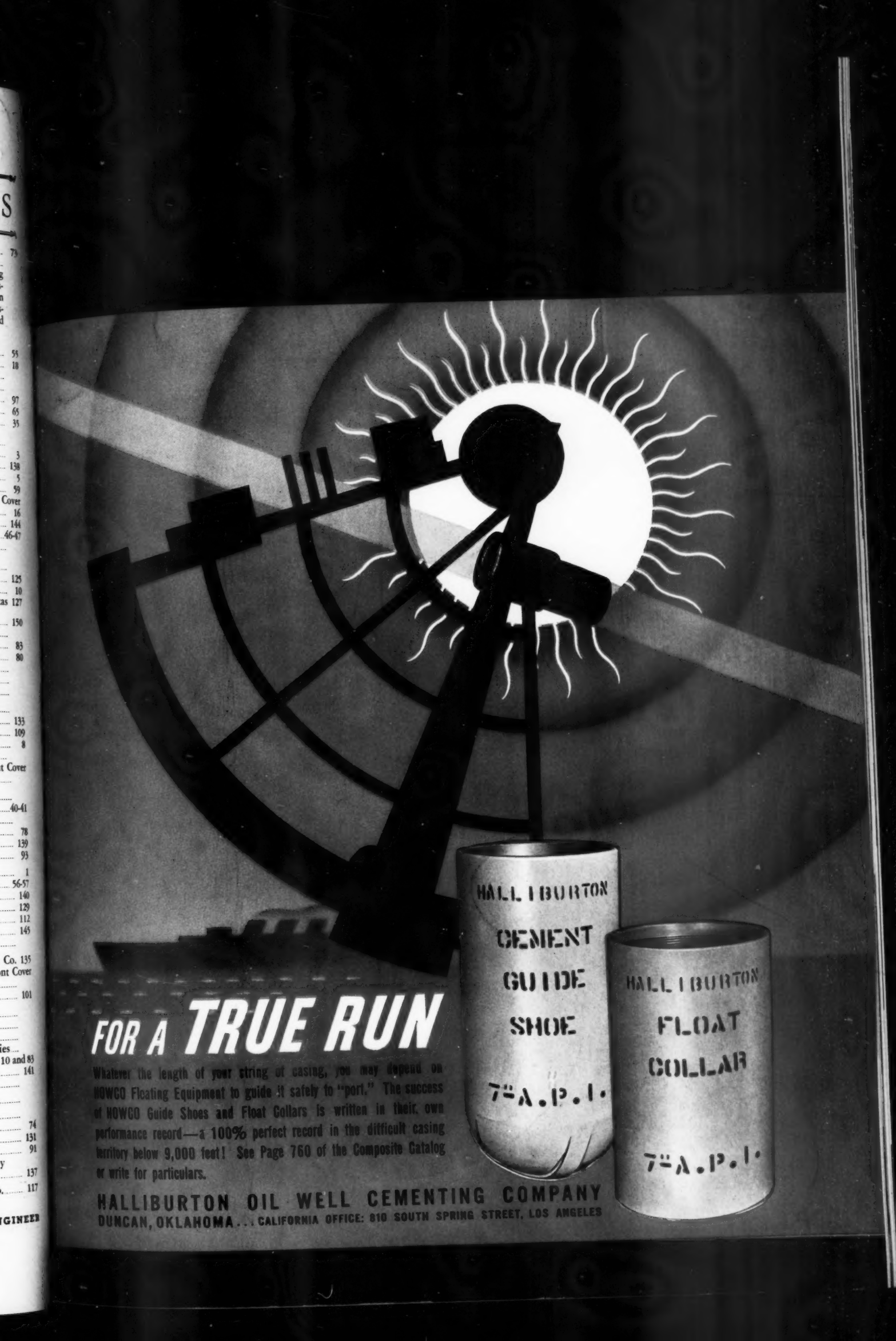

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Streams of Cut Oil

Top—Streams cut oil, Eldorado field, 1917.

Bottom—Cut oil, Eldorado, Kans., oil field, 1917.

•

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THE Petroleum Engineer • JULY 1937 • VOLUME VIII NUMBER 11

A MAGAZINE OF METHODS FOR OPERATING MEN

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Meetings

- California Natural Gasoline Association—August 5, Richfield Building, Los Angeles, California.
- American Chemical Society—September 6, 7, 8, 9, and 10, Rochester, New York.
- Pacific Oil Show and Black Gold Festival—September 16, 17, 18, and 19, Taft, California.
- American Gas Association, 19th Annual Meeting—September 27, 28, 29, 30, and October 1, Cleveland, Ohio.
- Society of Automotive Engineers, Fuels and Lubricants Regional Meeting—September 30 and October 1, Tulsa, Oklahoma.
- Oil-World Exposition, Inc.—October 11, 12, 13, 14, 15, and 16, Houston, Texas.
- Independent Petroleum Association of America, Annual Meeting—October 14, 15, and 16, Houston, Texas.
- American Asociation of Petroleum Geologists, Mid-Year Meeting—October 14, 15, and 16, William Penn Hotel, Pittsburgh, Pennsylvania.
- American Welding Society, 18th Annual Meeting and Welding Exposition—October 18, 19, 20, 21, and 22, Atlantic City, New Jersey.
- Mid-Continent Oil and Gas Association of Texas, Annual Convention—October 29, and 30, Dallas, Texas.
- American Petroleum Institute, 18th Annual Meeting—November 9, 10, 11, and 12, Stevens Hotel, Chicago, Illinois.
- International Petroleum Exposition—May 14, 15, 16, 17, 18, 19, 20, and 21, 1938, Tulsa, Oklahoma.

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The Course of Oil

By K. C. SCLATER

Percentage Depletion Allowance

In view of the efforts being made by the administration to induce Congress to deprive the oil industry of its right to depletion deduction in calculating income taxes, facts regarding percentage depletion are particularly to be desired. Here are capably outlined important aspects of the question at issue prepared by the staff of an independent operator. They demand serious consideration:

On June 1, 1937, President Roosevelt sent a message to Congress outlining methods of alleged tax evasion and tax avoidance being used by some of the wealthier taxpayers, and asked that measures be taken to stop the "loop holes."

With his message the President transmitted a report from the Secretary of the Treasury dated May 29, 1937, in which was enumerated, according to the Secretary's language, "seven principal devices now being employed by taxpayers with large incomes for the purpose of defeating the income taxes which would be normally payable by them." In his report the Secretary says of percentage depletion: "this is perhaps the most glaring loop hole in our present revenue law." In summing up the Secretary's report the President says: "this report reveals efforts at avoidance and evasion of tax liability, so wide spread and so amazing both in their boldness and their ingenuity that further action without delay seems imperative." The President requested that Congress "enact legislation at this session specifically and exclusively aimed at making the present tax structure evasion-proof."

It is apparent that the President made no attempt to separate the question of percentage depletion from the alleged tax-dodging schemes, because he says all the methods outlined in the Secretary's report are alike in that they are definitely contrary to the spirit of the law. It is clear, however, that the deductions from gross income allowed for percentage depletion is a legal right specifically granted by Congress, and consequently cannot be classed as one involving an evasion of the spirit or the letter of the law.

The percentage depletion allowance and its predecessor, the discovery depletion allowance, have been a part of the Internal Revenue Statutes for almost twenty years. There is little practical difference between percentage depletion and discovery depletion. Congress and the experts whom it employed have long considered and deliberated the question. The sections of the laws granting these rights have met the test of congressional investigations on numerous occasions and on each occasion they have received the stamp of approval. In 1933 the present Secretary of the Treasury recommended to Congress that percentage depletion be eliminated; but after proper hearings the proposal was not incorporated in the House Bill which emerged as the Revenue Act of 1934.

Charges against income for depletion of any wasting asset are permissible in order to provide the operator with a reserve of funds with which the wasted assets can be replenished. This is absolutely essential to assure continuance as a going concern in the case of all businesses based on exploiting and converting wasting natural resources. Otherwise, such a business is a single transitory venture that is concluded when the basic deposit is exhausted. As the basic deposit is exhausted the oil and gas contained therein are gone forever so far as human needs are conceived. Unlike a machine or a building, there is no certainty that an operator can replace an oil and gas well at the same cost as the one being exploited. The matter is one of conjecture. If the operator is relatively successful in the explorations conducted with his reserve funds, the result may obtain; if the explorations are relatively unsuccessful, then the wasted assets cannot be replenished at a cost equal to the cost of the old assets. Furthermore, the United States has a direct and vital interest in the discovery of new natural resources and throughout our history prospecting, exploration, and discovery have been encouraged and rewarded and the continuity and stability of responsible parties engaging in such businesses have been encouraged. The appropriate conservation of the wasting natural wealth of any nation depends on this. For these reasons and for others that will be discussed, Congress in 1919, when the Revenue Act of 1918 was enacted, provided that the deduction for depletion of mines and oil and gas wells could be based upon a value of discovered mines or oil and gas wells whenever that discovered value was substantially in excess of the cost or capital investment.

As in the case of all tax adjustments founded on the necessity of human or opinionated valuations, the administration of the deductions for depletion soon developed inequities, inequalities between taxpayers and much confusion of application and delays of litigation.

To effect simplicity of administration, equality of application and to achieve with close approximation the same revenue results to the Government, the right to measure depletion by discovery value was, in the case of oil and gas wells, superseded in the 1926 Act (starting January 1, 1925) by rights to measure depletion deduction by a percentage of income.

Under the present law, the determination of the depletion allowances for each property is based upon percentage depletion, depletion on March 1, 1913, value, or depletion of cost, whichever is highest. From these rules it is clear that in the case of oil and gas wells the percentage allowances apply only in cases where the capitalized costs are relatively low, and for the most part on properties where discoveries of new mineral values have been made.

In all cases since 1932 where there is an allowance of depletion based upon a percentage of income, the amount allowed or allowable serves to reduce the basis of cost upon which cost depletion is computed. If the property is sold, the gain or loss recognized from the sale is measured by a cost reduced by the depletion previously allowed, including since 1932 all allowances measured by a percentage of income. Thus a double deduction of capital investment on the sale or other disposal of the property is avoided.

When one considers these rules, the conclusion becomes evident that no estimates, having any warranty of accuracy, can be made of the amount by which the taxes of the petroleum industry are diminished by the application of these rules. In time of depression and low prices for products, there is little, if any, advantage. In prosperous times, the advantages are relatively high provided the properties are not sold. In case of a sale prior to the time the cost is fully depleted, there is no advantage. Thus, any estimate of the amount of additional taxes that could be gathered from a repeal of those sections of the revenue laws would be merely a wild conjecture.

There is ample justification for the provisions of the Federal income tax laws that permit deductions for depletion of oil and gas wells to be measured by a percentage of income from the producing properties. Some of the principal reasons why there should be no change in percentage depletion allowances are set forth below:

1. Taxpayers who have performed and will perform special valuable services for the Nation are entitled to percentage depletion deductions.
2. Any additional revenue derived from revocation of the rights to measure depletion by a percentage of income will be more than offset by the public detriment resulting from such revocation.
3. There is intrinsic merit in the principles that permit depletion to be measured by a percentage of income and these allowances can be justified upon sound economic and legal principles.
4. Percentage depletion is justified because its provisions promote accuracy and simplicity in the administration of the tax law.

It must be clear that this question, so vitally important to the stable, orderly, and non-wasteful development of America's natural resources, cannot be eliminated or lightly dismissed by the general, superficially brief scare-head type of statements quoted above from the Secretary's tax message. These are technical matters. Small changes even in administrative application run quickly into large amounts either for the taxpayer or the Government. Lengthy and accurately detailed discussion and consideration of such a matter cannot and should not be avoided. Untold harm to taxpayers and to the country lies in the determination of such questions on the basis of politics, or on any attempt to associate them with alleged tax-dodging schemes, or on ignorance of the full facts and consequences of a change from an established system on which the natural resources industries have been encouraged to rely and plan.

« « HIGHLIGHTS IN OILDOM » »

Sun Drilling Wildcat in Washington State

A wildcat test being drilled by the Sun Oil Company in the state of Washington is being watched with great interest. The test has just been spudded in Clallam County, in the southwestern part of the county near Calawah River. The Sun has a block of approximately 15,000 acres centering around the town of Forks, which includes many townships. The location is in the Bloedell Ruddock land in township 28n, range 13w, on a closed anticlinal structure. The structure is reported highly promising. Two small gas seepages are found at the river a short distance from the test.

●

Plan Control Program for Tri-State Rodessa Field

Since the Rodessa field became a tri-state affair with its extension into Miller County, Arkansas, the question of its control and orderly development naturally has arisen. A formal hearing will be held July 20 to receive testimony and frame regulations for well spacing, casing, allocation of quotas, etc. Pending the hearing the control board is refusing to issue any permits for wells on small tracts, thus checking the usual flood of applications on small leases following a discovery of importance.

Prospects are bright for adoption of a control program similar to Louisiana and Texas. Hearings have been held at Texarkana and El Dorado by the Arkansas Conservation Board. At those hearings little opposition was voiced to a program of orderly development and production.

●

Crude Prices Increase in Southwest Texas

Heavier grades of Southwest Texas crudes were given a price advance early in the month, first by the Magnolia Petroleum Company and later by the Humble Oil and Refining Company and the Atlantic Petroleum Purchasing Corporation. All advances were as of July 6.

The Magnolia, through its president, D. A. Little, announced new postings on the heavier grades of Mirando crudes as follows: Below 21 gravity, 96 cents, an increase of 6 cents; 21 to 21.9 gravity, 98 cents, an increase of 5 cents; 22 to 22.9 gravity, $1.00, an increase of 4 cents; 23 to 23.9 gravity, $1.02, an increase of 3 cents; 24 to 24.9 gravity, $1.04, an increase of 2 cents or more; 25 to 25.9 gravity, $1.06, an increase of 1 cent.

The Humble and Atlantic met these postings on Mirando crudes and announced price increases on Refugio crudes. The Atlantic posted these prices: below 21 gravity, $1.01 a bbl., an increase of 6 cents; 21 to 21.9 gravity, $1.03, an increase of 5 cents; 22 to 22.9 gravity, $1.05, an increase of 4 cents; 23 to 23.9 gravity, $1.07, an increase of 3 cents; 24 to 24.9 gravity, $1.09, an increase of 2 cents; 25 to 25.9 gravity, $1.10, up 1 cent; 26 to 26.9 gravity, $1.11, an increase of 1 cent a barrel.

The Humble posted this same schedule with a top of $1.11 a bbl. for 25 gravity and above. The Atlantic continued the postings with a differential of 2 cents per degree up to $1.41 a bbl. for 40 gravity and above.

Say Gas Wastage Can Be Avoided

Oil can be produced without gas wastage by casing through gas-bearing sands to the oil horizon, it was stated before a hearing of the Kansas Corporation Commission at which testimony was received on production methods in the Otis field of Rush and Barton counties. Ralph Damp, district engineer, and F. W. Floyd, manager of the production department, of the Carter Oil Company, said wells operated in the field by their company were being produced with only a small gas wastage as a result of the adoption of this method.

The commission is hearing charges by land-owners and gas producers that operators of combination oil and gas wells are depleting the field's reserves by permitting the gas to blow to atmosphere during production operations.

●

Stricter Rules Governing Reports of Operators

The Texas Railroad Commission has made stricter its rules governing the numerous reports that are required of oil operators. A major change has been in the form of affidavit required concerning production, authorization, forecast tenders, crude oil tenders, oil products tenders, tender operations statements, manifest reports, monthly pipe line and crude oil storage reports, refining, processing, reclaiming, blending, and treating. The latest order states that it has been found necessary to make the oath "an unequivocal affidavit that the facts and figures set forth in the respective reports are within the knowledge of the affiant true and correct."

A new report required of operators is one giving in detail the status of wells each month. Data required on this report includes lease number, well number, well condition, daily average oil production, and gas-oil ratio, the latter two to be supplied when ordered by the commission. The condition of wells is classified as flowing, agitating, pumping, and dead.

Data obtained in the reports are used by the commission in making its monthly summary of crude movements in Texas.

●

To Search for Oil and Gas in Sweden

Skanska Cement AB., Malmo, the largest producer of cement in Sweden, has applied to the County Board at Visby, Gottland, for a concession to prospect for and exploit gas and oil deposits within an area of 1325 hectares of the so-called File-Haidar district east of the Tingstade marsh in the Tingstade and Hejnum parishes and the Slite township.

Geological and geophysical investigations undertaken by the company on the island of Gottland have shown File-Haidar to be one of the most promising districts for oil and gas deposits.

It was stated in the press that the chief director of Sweden's Geological Survey intends to apply for a government appropriation toward a thorough investigation of possible deposits of oil, gas, and rock salt in southwestern Skane.

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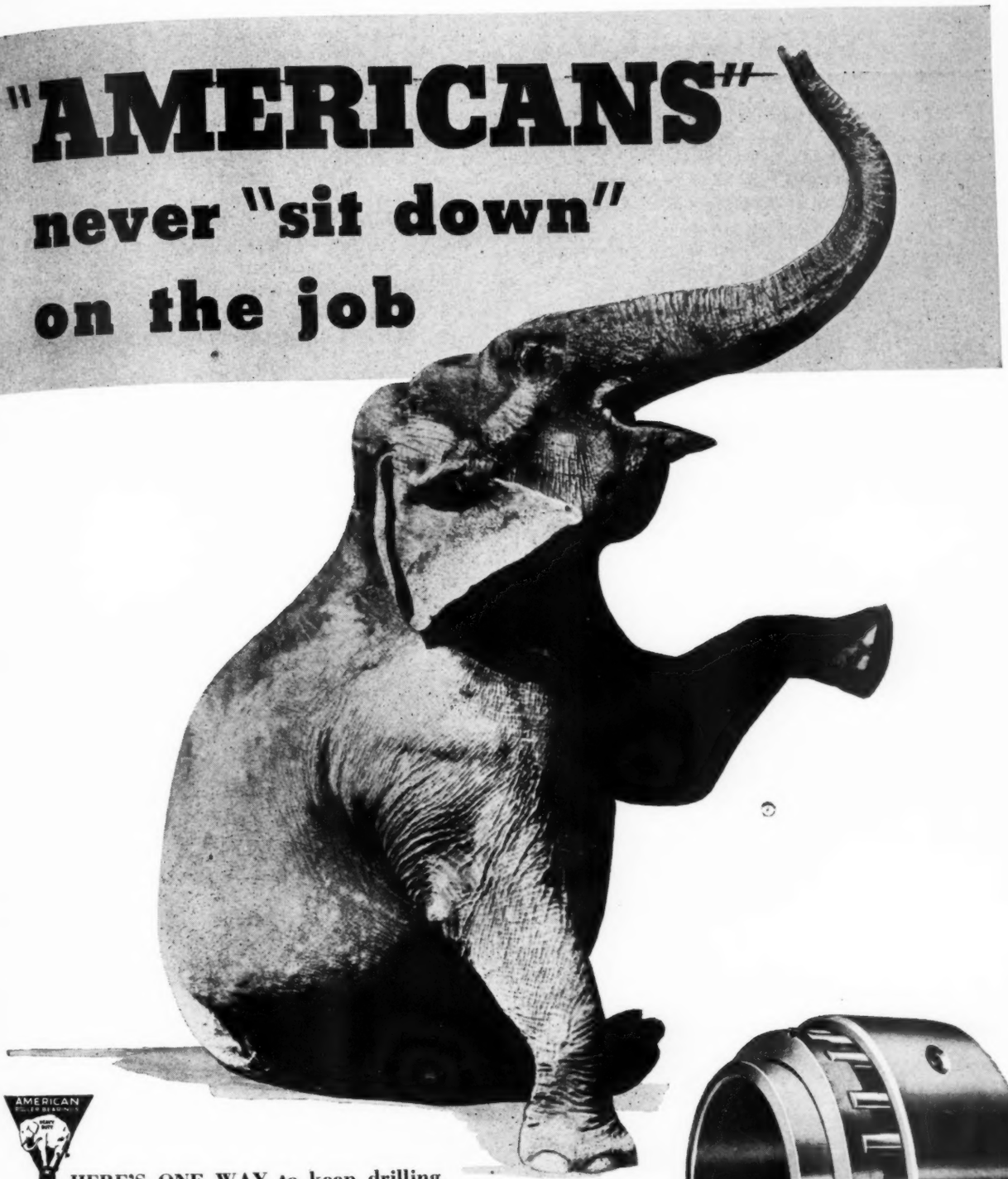

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AMERICAN HEAVY DUTY ROLLER BEARINGS

Progress of Major Pipe Line Work

CONSTRUCTION work on the Texas-New Mexico Pipe Line Company's system, which will increase the line's capacity from 30,000 bbl. to 75,000 bbl. daily, is well underway. This is the company formed recently by The Texas Company, Consolidated Oil Company, Tide Water Associated Oil Company, and the Empire Oil and Refining Company. The line is The Texas Company's West Texas system. Nine new stations are to be constructed, three others redesigned and enlarged, and new pipe line laid.

Three of the stations, at Monahans, Ward County, Ozona, Crockett County, and Junction, Kimble County, are expected to be completed by August 1. They will increase the capacity of the line to 41,000 bbl. daily. The remaining new stations, at Iraan, Pecos County, New Ulm, Colorado County, Sonora, Sutton County, Fredericksburg, Gillespie County, Blanco, Hays County, and Katy, Waller County, likely will be ready by November 1st. The three old stations that will be remodeled and have installations made are at Crane, Crane County, Jal, Lea County, New Mexico, and Rosanky, Bastrop County.

All stations will be Diesel powered, except at Jal where there is a combination Diesel-gas engine setup. Each station will have 1200 horsepower. Some stations will have two 600-hp. engines and others three 400-hp. engines. Katy, New Ulm, and Blanco stations will be equipped with centrifugal pumps, the others with reciprocating units.

On the trunk line 40 miles of 12¾-in. loops are being laid, and 11 miles of 6-in. laterals from the Monahans station to the South Ward area.

●

The Keystone Pipe Line Company and the Buffalo Pipe Line Company, transportation affiliates of the Atlantic Refining Company, have awarded a contract for the laying of a 213-mile 8-in. welded gasoline line and construction work began July 1st. T. R. Jones and W. G. Hanrahan, of Dallas, Texas, have been given the contract. The line will run across north-central Pennsylvania and western New York. It will extend northwest from Williamsport to Buffalo, with a branch north to Rochester. From Buffalo and Rochester the company will ship by water on Lake Erie and Lake Ontario.

Two gangs will work north and south from the New York-Pennsylvania border, and later a third will be added. It is planned that the project will be completed by November 1st.

National Tube Company, Pittsburgh, Pennsylvania, will supply the line pipe.

●

The Leonard-McClanahan Pipe Line Company has been organized to relieve the congested condition of the Buckeye area of Michigan. It is composed of the McClanahan Pipe Line Company and the Leonard Group. Originally it was planned to construct a 40-mile 6-in. line from the field to Alma and St. Louis where McClanahan and Leonard have refineries. That plan has been abandoned, however, and in its stead an agreement has been reached whereby the Pure Transportation Company will move McClanahan-Leonard oil from the Buckeye field to Greendale tank farm through the company's new 6-in. line. The Leonard-McClanahan Pipe Line Company is laying a 6-in. line from the tank farm south six miles to tie in at the Yost booster station with McClanahan Pipe Line Company's old double 4-in. line from Alma to Yost. Leonard-McClanahan also have purchased the 4-in. line of the Mid-West Pipe Line Company from Alma to Crystal field.

●

The Cities Service Gas Company has begun construction of a dehydration plant at its Pampa, Texas, compressor station, which is expected to be completed and in operation by October.

Officials of the company state that during the winter months there has been a noticeable reduction in the capacity of the 20-in. line from Pampa to Wichita, Kansas, due to free water, ice, or liquid hydrocarbons, which form in the lines. This has resulted in reduction of the volume of gas that can be transported, and at a time when winter demand requires a heavy load. The dehydration plant is to overcome this condition and permit operation of the 20-in. main line at higher pressures with a consequent increase in volume of gas delivered.

In connection with this installation two field compressor units of 230 hp. each will be constructed at strategic points, and some gathering lines will be laid in order to take gas from wells that will not deliver their full allowable against the pressure when the capacity of the line is increased.

●

Facilities of the Shell Pipe Line Company between Cushing, Oklahoma, and St. Louis, Missouri, are to be expanded. At present the system consists of a 10-in. line and numerous loops. By the laying of 75 miles of 10-in. line these loops will be connected, providing two continuous 10-in. lines. The capacity of the line thus will be increased considerably. The A. O. Smith Corporation has been given a contract to supply the pipe, totaling 8000 tons.

●

The Latex Construction Company of Houston, Texas, has been awarded a contract by the Humble Oil and Refining Company to lay a 39-mile 8-in. welded gas line from the company's Satsuma station in Harris County to the Baytown refinery.

The Latex Construction Company also has received a contract to lay 15 miles of 6-in. oil line from the Spurger field in northeastern Tyler County to the Silsbee field in Hardin County where it will connect with the Atlantic Refining Company's trunk line.

●

The Solomon area of northern Ellis County, Kansas, is being given a pipe line outlet. The Stanolind Pipe Line Company is laying a 4-in. line from the Zurich pool, southern Rooks County, to the Solomon area.

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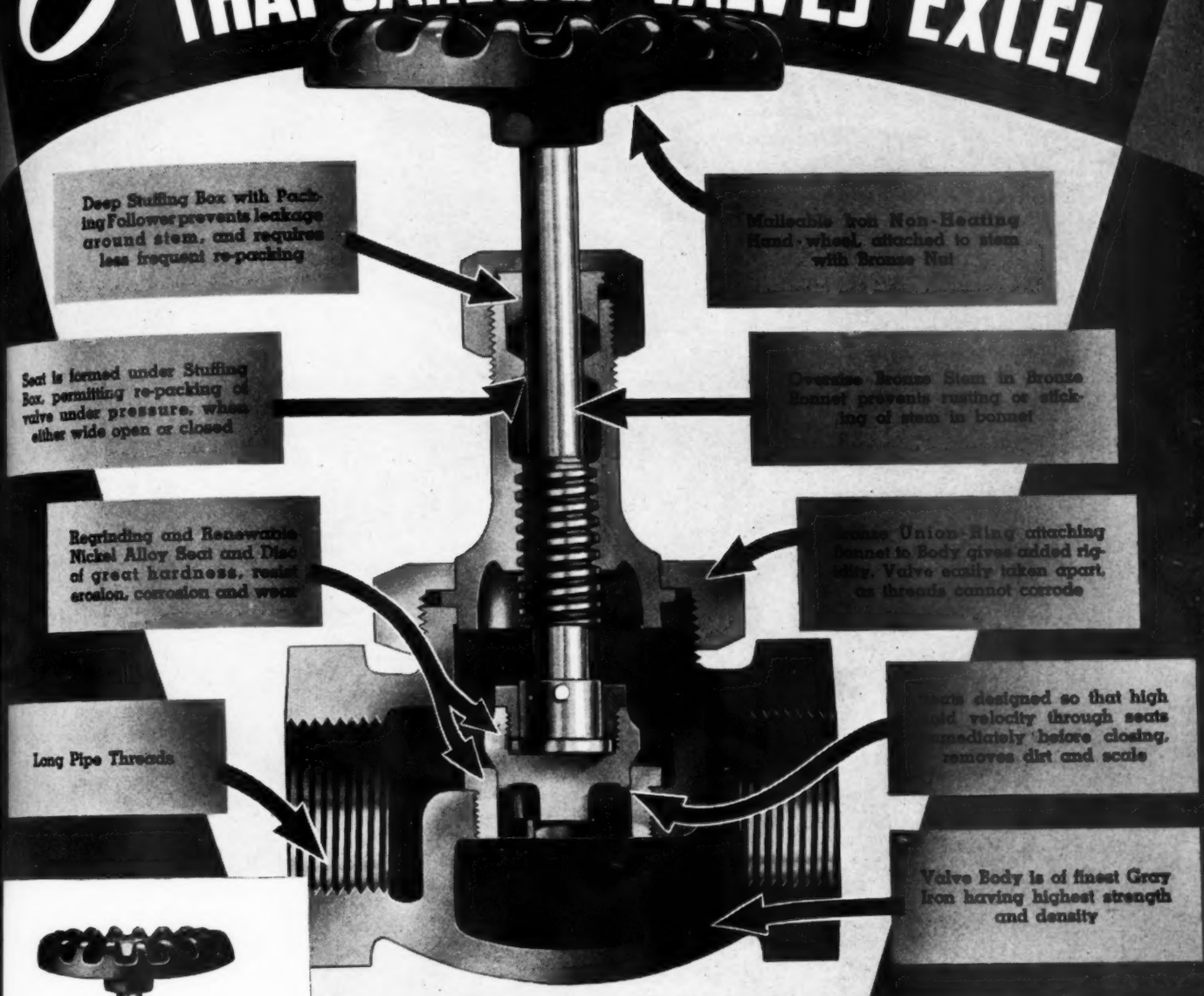
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Oversize Bronze Stem in Bronze Bonnet prevents rusting or sticking of stem in bonnet
Regrinding and Renewable Nickel Alloy Seat and Disc of great hardness, resist erosion, corrosion and wear
Bronze Union-Ring attaching Bonnet to Body gives added rigidity. Valve easily taken apart, as threads cannot corrode
Long Pipe Threads
Seats designed so that high fluid velocity through seats immediately before closing, removes dirt and scale
Valve Body is of finest Gray Iron having highest strength and density

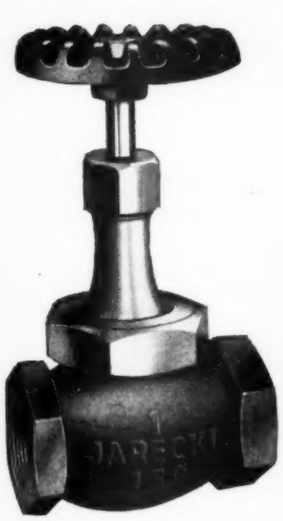

Fig. 410-C—JARECKI Nickel Seat and Disc Valve. Designed especially for throttling service on Oil, Gasoline or Steam Lines. 150 Pounds Steam Working Pressure. . . . 200 Pounds Oil, Water or Gas Non-Shock Working Pressures.

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See JARECKI Section, 1937 Composite Catalog

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Latest Activities In The Oil Fields

THE Brooksville-Marvin-Tecumseh section of Pottawatomie County, Oklahoma, is the newest Simpson dolomite sand area of the Greater Seminole field. Stanolind Oil and Gas Company and the Amerada Petroleum Corporation's No. 1 Billington is the first well completed in the area. Showing first as a small Simpson dolomite well, and then as a better producer in the second Wilcox sand, it was tested and showed water. Plugged back to the dolomite and acidized the well appears to be good for 1000 to 1200 bbl. daily. Total depth is 5328 feet.

Rodessa was made a tri-state field when W. L. McClanahan et al brought in their No. 1 Capps as a producer one-half mile north of the Arkansas line in Miller County. The well flowed following treatment with acid and on an 18-hour gauge made 585 bbl. of 41-gravity oil. Total depth of the well is 6113 feet.

A shallow discovery in Converse County, Wyoming, is looked upon as being of importance, as it is expected to stimulate activity in the southeastern part of the Powder River Basin. The Wyoming Southern Oil Company recently found production at 586 ft. in the West Shawnee area 15 miles east of Douglas with its No. 1 Jennie Evert. It is estimated as good for a daily production of 25 to 35 bbl. of 24.8-gravity oil.

Gaines County, Texas, was given its third oil field recently when Amon G. Carter and Continental Oil Company's No. 1 A. L. Wasson was completed making a natural flow of 333 bbl. of 34½-gravity oil from a total depth of 4959 feet. The well was flowing through ¾-in. choke. The gas-oil ratio was 20,000 cu. ft. of gas to one bbl. of oil.

The wildcat test, No. 1 Settegast, of the Humble Oil and Refining Company at Friendswood, Harris County, Texas, appears likely to open a new field. Drilled to a depth of 6040 ft., 189 ft. of oil sand was cored, after which the test was plugged back to 6009 ft. and 7-in. casing set at 5802 ft. to test the Frio sand.

Iron Mountain Oil Company and the Humble Oil and Refining Company have given Jones County, Texas, its largest producer with their No. 1 Olander. On the initial gauge the well produced 630 bbl. of oil. Production is from the Palo Pinto lime at the base of the Canyon series at a total depth of 3250 feet. The well is approximately six miles north of the Leuders field.

A small new pool in Barton County, Kansas, seems likely with the finding of production by S. E. Bailey et al's No. 1 Hammeke, east of Claflin. Although surrounded by dry holes the test had a good showing of oil in the Siliceous lime at a depth of 3427 feet. Nearest production is four miles to the southeast.

No. A-1 Ramsey of the Pullman Oil Company, in DeSoto Parish, Louisiana, has revived interest in the south end of the Sabine Uplift. This well has been completed in the Paluxy at a total depth of 2961 ft., producing 325 bbl. of oil in 11½ hours through 1¼-in. choke. The gravity of the oil is 39 deg. A. P. I.

According to reports a new oil field has been discovered near the mouth of the Soengei Besitang River in Sumatra by De Bataafsche Petroleum Maatschappij, operating subsidiary of the Royal Dutch Shell in Netherlands India. The discovery well was the first test drilled in the area. Operators are of the opinion this may prove to be a strike of major importance.

In the Devil's Den area of Kern County, California, the Amerada Petroleum Corporation completed its No. 4 Beer wildcat at a depth of 2670 ft., making 25 bbl. of oil daily on the pump. The oil analyzes 25 gravity.

A good showing of oil has been had by the Stanolind Oil and Gas Company in its No. 1 Schartz, three miles east of Ellinwood in Barton County, Kansas. If this test proves to be a commercial producer it will open a new pool.

AVERAGE CRUDE PRICES

California	
Kettleman Hills	$1.19-1.43
Playa Del Rey	.80-1.16
Coalinga	.70-.90
Signal Hill	.80-1.21
Montana	1.35
Wyoming	.97-1.30
Colorado	1.12-1.18
New Mexico	.78-1.08
Texas	
North Central	.96-1.20
Panhandle	.91-1.08
West Texas	.78-1.08
Gulf Coast	.95-1.41
Darst Creek	1.09
East Texas	1.35
Talco	.73
Kansas	.98-1.30
Oklahoma	.98-1.30
Arkansas	.90
Louisiana	
Rodessa	$ .91-1.25
Gulf Coast	.84-1.41
North Louisiana	.90-1.22
Illinois	1.35
Kentucky	1.40
Indiana	1.12
Ohio	
Lima	1.25
Michigan	1.42
Pennsylvania	
Bradford	2.82
Southwest	2.57
Eureka	2.52
Buckeye	2.37
Corning	1.42
West Virginia	1.67
Canada	2.10-2.17

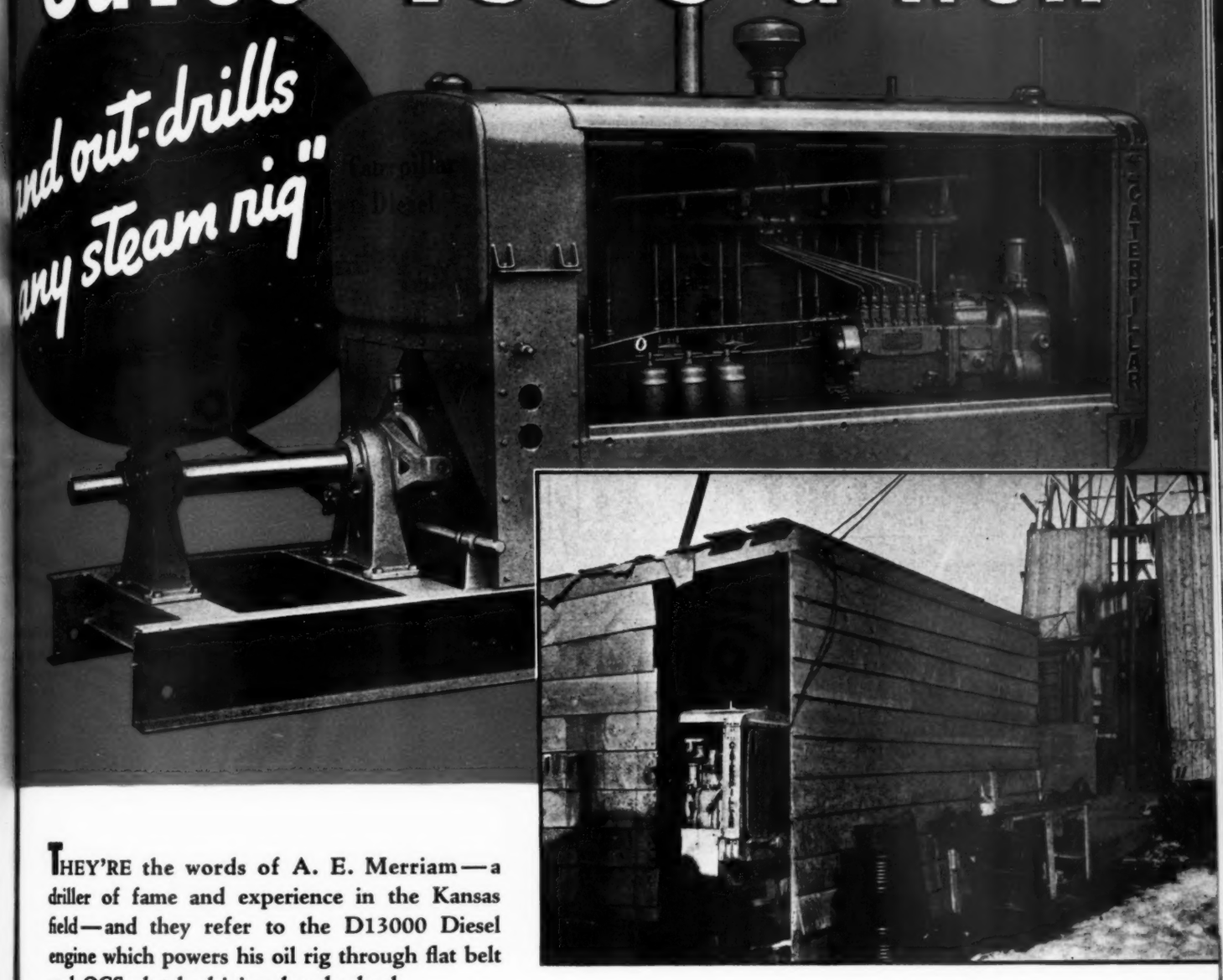
DAILY AVERAGE CRUDE OIL PRODUCTION

Data Supplied by A.P.I.

(Figures in Barrels)

	B. of M. Dept. of Int. Calculations (July)	Actual Week Ended July 3, 1937	Week Ended May 29, 1937	Week Ended July 4, 1936
Oklahoma	629,700	619,600	660,800	508,650
Kansas	195,600	193,000	202,650	144,750
Panhandle Texas	.....	80,500	87,100	61,250
North Texas	.....	72,600	74,050	59,100
West Central Texas	.....	33,650	32,950	25,300
West Texas	.....	200,600	209,900	181,400
East Central Texas	.....	123,750	124,050	53,650
East Texas	.....	466,550	462,200	424,850
Southwest Texas	.....	236,450	236,350	151,550
Coastal Texas	.....	202,500	206,700	177,600
TOTAL TEXAS	1,375,100	1,416,600	1,433,300	1,134,700
North Louisiana	.....	88,300	78,750	77,750
Coastal Louisiana	.....	173,050	167,850	146,000
TOTAL LOUISIANA	253,000	261,350	246,600	223,750
Arkansas	28,400	28,350	27,150	30,050
Eastern	122,100	123,550	119,650	110,400
Michigan	39,800	43,100	44,450	38,950
Wyoming	52,900	48,900	49,800	37,000
Montana	16,200	17,200	15,400	17,050
Colorado	4,700	4,300	3,600	5,000
New Mexico	100,800	114,600	112,200	73,200
TOTAL EAST OF CALIF.	2,818,300	2,870,550	2,915,600	2,323,500
California	605,500	655,100	658,100	568,800
TOTAL U. S.	3,423,800	3,525,650	3,573,700	2,892,300

"saves $1000 a well and out-drills any steam rig"



THEY'RE the words of A. E. Merriam—a driller of fame and experience in the Kansas field—and they refer to the D13000 Diesel engine which powers his oil rig through flat belt and OCS clutch driving band wheel.

Since it replaced his steam rig, this engine has operated more than 5000 hours—running 24 hours a day on an average of 52 gallons of low-cost Diesel fuel—and costing only $12 for repairs. Mr. Merriam further states that he has been "drilling circles around" a steam-powered rig operating on a nearby lease; that he rarely touches his engine—and that *he does a lot of boosting for "Caterpillar" Diesels.*

What is true of drilling is also true of line pumping—or any other job to which this most modern type of power is assigned:—The big word it spells is E-C-O-N-O-M-Y. Have *you* a power problem? Are you interested in facts and figures? "Caterpillar" dealers have both aplenty. Or, write us direct.

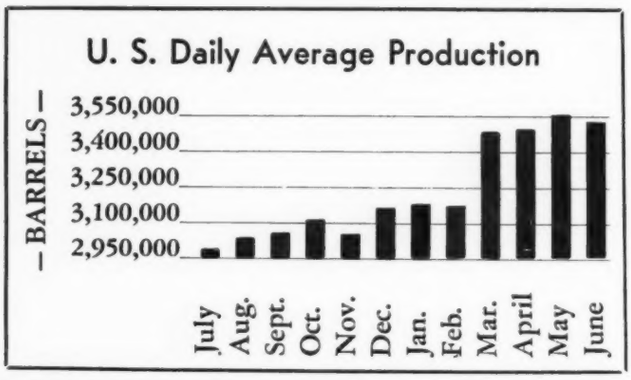
SEVEN ENGINE SIZES—from 44 to 160 hp.

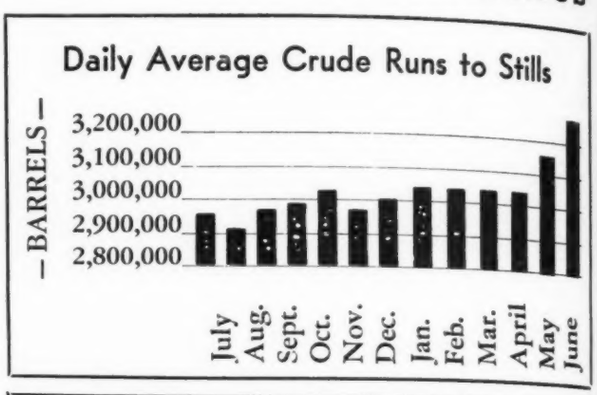
CATERPILLAR DIESEL ENGINES

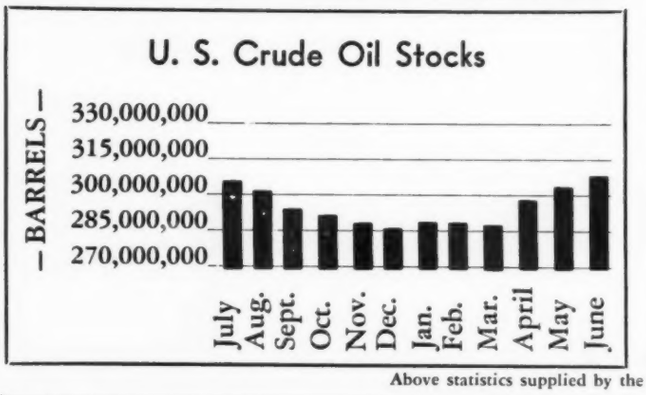
REG. U.S. PAT. OFF.

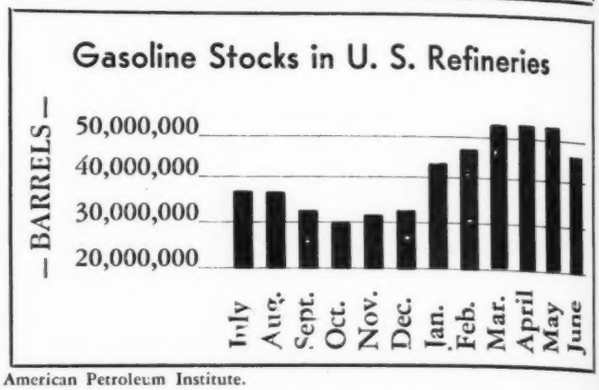
CATERPILLAR TRACTOR CO., PEORIA, ILLINOIS—WORLD'S LARGEST MANUFACTURER OF DIESEL ENGINES

Summary of Petroleum Statistics and Field Activities









Above statistics supplied by the American Petroleum Institute.

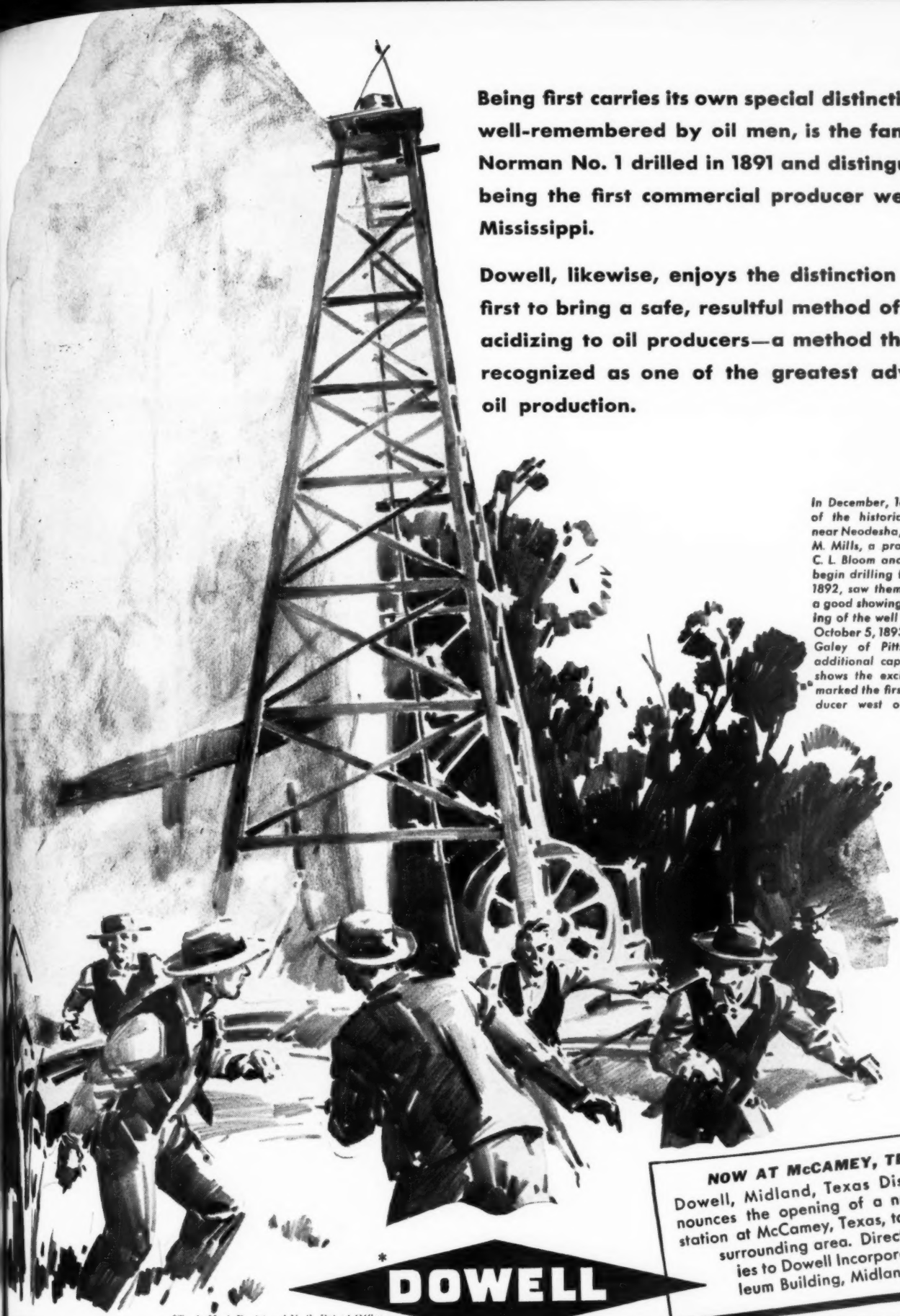
Summarized Operations in Active Fields for June, 1937

Fields	Completions	Producers	Rigs	Drilling Wells	Depth of Production	No. Casing Strings	Gravity of Oil	Type of Tool Used
Texas								
East Texas	231	226	54	132	3500-3700	2	40	Rotary
Duval County	63	50	21	61	1554-2900	2	22	Rotary
Archer County	39	12	3	15	660-1800	1 or 2	40	Rot.-Cab.
Panhandle	81	81	61	133	1700-3900	2	40	Rotary
Refugio	18	17	3	13	4900-5900	2	38	Rotary
Nueces County	62	52	26	63	3922-5878	2 or 3	21-54	Rotary
Winkler County	73	73	21	65	2850-3450	2 and 3	30-38	Rot.-Cab.
Talco Field	42	42	7	40	4230-4361	2	16-24	Rotary
Oklahoma								
Oklahoma City	5	5	2	11	6450-6682	3	39	Rotary
Fitts Pool	68	63	10	52	1800-4488	2 or 3	38	Rotary
Osage County	9	6	5	21	380-2850	2	37.5-40	Rot.-Cab.
Kansas								
Russell County	43	40	9	63	2926-3435	2 and 5	32-37	Rot.-Cab.
Rice County	55	43	10	62	3222-4085	2 and 5	42-48	Rot.-Cab.
Reno County	25	24	5	29	3300-4375	2 and 5	42-48	Rot.-Cab.
Louisiana-Texas								
Rodessa	32	29	10	49	5950-6450	3	39	Rotary
New Mexico								
Lea County	70	67	15	102	3150-4030	3	30-34	Rot.-Cab.
California								
Kettleman Hills	2	2	5	12	8300-8730	3 or 4	40	Rotary
Wilmington	55	55	47	46	3500-4000	2 and 3	18-20	Rotary
Midway-Sunset	14	13	19	21	1400-3100	1 and 2	11-30	Rot.-Cab.

Field Activities by States for June, 1937

State	Completions		Producers		Locations		Rigs		Drilling Wells		Production, 1936 (In Barrels)
	June	May	June	May	June	May	June	May	June	May	
Arkansas	12	8	5	3	27	17	14	14	50	53	10,461,000
California	158	128	128	104	155	191	166	137	300	273	214,883,000
Colorado	....	....	....	....	....	....	4	2	35	29	1,670,000
Illinois	22	15	16	8	....	....	59*	42	30	16	4,452,000
Indiana	13	1	7	....	....	....	3	9	41	43	795,000
Kansas	240	227	183	176	232	355	89	99	486	497	58,226,000
Kentucky	65	19	52	14	....	....	29	31	75	72	5,653,000
Louisiana	114	86	83	63	114	222	61	65	320	334	79,980,000
Michigan	93	96	79	73	117	110	116	114	173	154	11,852,000
Mississippi	....	....	....	....	....	....	6	5	12	12	Gas Prod.
Montana	25	19	24	17	....	....	8	9	64	54	5,632,000
New Mexico	70	69	67	67	....	....	24	23	156	141	27,134,000
New York	2	....	0	....	....	....	8	6	40	41	4,637,000
Ohio	134	93	94	70	....	....	94	92	273	270	3,834,000
Oklahoma	286	337	172	249	247	283	72	78	504	541	206,082,000
Pennsylvania	....	....	....	....	....	....	....	....	....	....	15,830,000
Texas	1607	1342	1280	1053	1545	2171	611	641	2007	2157	391,097,000
West Virginia	91	74	68	60	....	....	30	25	160	155	3,903,000
Wyoming	8	11	7	8	....	....	14	10	60	54	13,650,000
Total	2940	2524	2265	1965	2437	3449	1408	1402	4786	4896	993,942,000

*Including 36 rigs standing and 23 rigging up



Being first carries its own special distinction. Thus, well-remembered by oil men, is the famous T. J. Norman No. 1 drilled in 1891 and distinguished as being the first commercial producer west of the Mississippi.

Dowell, likewise, enjoys the distinction of being first to bring a safe, resultful method of *inhibited* acidizing to oil producers—a method that is now recognized as one of the greatest advances in oil production.

In December, 1891, on the bank of the historic Verdigris River near Neodesha, Kansas, Major W. M. Mills, a prospector, engaged C. L. Bloom and A. P. McBride to begin drilling for gas. February, 1892, saw them at 803 feet with a good showing of oil. The shooting of the well was delayed until October 5, 1893, after Guffey and Galey of Pittsburgh furnished additional capital. Our picture shows the exciting moment that marked the first commercial producer west of the Mississippi.

NOW AT McCAMEY, TEXAS

Dowell, Midland, Texas District, announces the opening of a new service station at McCamey, Texas, to serve the surrounding area. Direct all inquiries to Dowell Incorporated, Petroleum Building, Midland, Texas.

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OIL AND GAS WELL CHEMICAL SERVICE

The Month's Activities In Refining

Percent Refinery Capacity Operated

Western Division, 68.1 Percent **Central Division, 76.3 Percent** **Eastern Division, 85.9 Percent**

THE Ohio Oil Company plans the construction of a road oil-processing plant and refinery at Lovell, Wyoming, to handle crude from the Byron-Garland fields in Big Horn County, northern Wyoming. As a part of the project an 8-in. pipe line will be laid from the Byron-Garland fields to Lovell, a distance of 15 miles. The Ohio Oil Company has purchased a refinery site at the latter point. Further details concerning the project have not been announced.

●

Officials of the Humble Oil and Refining Company announce that a natural gasoline plant having a capacity of 25,000,000 cu. ft. of gas daily will be constructed in the Dickinson field, Galveston County, Texas. The contract for erecting the plant has been let to the Western Supply Company, Tulsa, Oklahoma.

●

The refinery and asphalt plant of the Talco Asphalt and Refining Company at Mt. Pleasant, Texas, has been placed in operation. For the time being only the skimming unit is being operated, but the cracking unit is expected to be completed soon. Crude oil supply is from the Talco field and when completed the capacity will be from 5000 to 7000 bbl. daily.

The Talco Asphalt and Refining Company is composed of Capt. J. F. Lucey, D. Harold Byrd, Jack Frost, and Ralph E. Fair. Headquarters are in Dallas, Texas. J. K. MacKinnon is general manager of the plant, and C. O. Garbrecht is superintendent.

●

The Rodessa Gasoline Company's 25,000,000-cu. ft. absorption-type gasoline plant in the Rodessa field, has been purchased by the Great National Oil Corporation, a new concern with headquarters at Shreveport, Louisiana. The plant will be enlarged and modernized immediately, it is announced. The announcement also says that a distillation unit will be added to operate in conjunction with the absorption unit.

Bids are being received by the Richfield Oil Corporation for construction work at its Watson, California, refinery that will involve the expenditure of $5,000,000 within the next 12 months. Two combination units, each having a daily charging capacity of 30,000 bbl., and a polymerization unit having a daily capacity of 6,000,000 cu. ft. of gas, are to be added, increasing the plant's capacity by approximately 25 percent.

●

The Standard Oil Company of New Jersey, through subsidiaries, has awarded a contract to Alco Products, Inc., for the construction of 16,000-bbl. topping unit at its refinery on the island of Aruba.

●

The Petrol Corporation, Los Angeles, California, has taken over and is operating a 3500-bbl. refinery formerly owned by the Fletcher Oil Company and which has been shut down for more than a year. The Petrol Corporation also has a 6500-bbl. skimming and asphalt plant in Los Angeles.

The Ring Oil Company has taken over and reopened the old Shepherd and Pendleton refinery at Seal Beach and will manufacture gasoline, gas oil, and fuel oil.

●

The capacity of the Globe Oil and Refining Company's plant at McPherson, Kansas, is being increased 3000 bbl. daily by the installation of an additional tube still. The unit was designed by the company's own engineers.

●

The active Wilmington, California area soon may have three natural gasoline plants. The General Petroleum Corporation is completing its plant and initially will manufacture approximately 25,000 gal. of gasoline daily. C. B. Edington has purchased the State Company's plant at Long Beach and plans to move it to Wilmington. The Gilmore Oil Company also has under consideration the erection of a plant in the area.

Crude Runs to Stills, Gasoline and Gas and Fuel Oil Stocks

Week Ended July 3, 1937

A.P.I. Figures

(Figures in Barrels of 42 Gal. Each)

DISTRICT	Percent Potential Capacity Reporting	Daily Avg. Crude Runs to Stills	Percent Operated of Total Capacity Reporting	Total Motor Fuel Stocks Thousands of Bbl.	Gas and Fuel Oil Stocks Thousands of Bbl.
East Coast	100.0	564,000	84.3	19,339	8,897
Appalachian	88.4	107,000	82.9	2,896	775
Ind., Ill., Ky.	92.1	423,000	90.6	12,829	5,968
Okla., Kans., Mo.	84.6	301,000	79.2	7,898	3,208
Inland Texas	56.6	131,000	65.2	1,955	1,669
Texas Gulf	95.5	724,000	95.6	9,039	7,489
La. Gulf	96.3	131,000	82.9	1,495	2,354
No. La.-Ark.	63.7	34,000	58.6	479	382
Rocky Mt.	69.7	38,000	61.3	1,805	755
California	90.9	558,000	74.8	13,527	67,517
Reported	88.8	3,011,000	83.0	71,262	99,014
Est'd Unreported	.....	259,000	.....	3,410	2,170
*EST'D TOTAL U. S., July 3, '37	.....	3,270,000	.....	74,672	101,184
*EST'D TOTAL U. S., June 26, '37	.....	3,235,000	.....	75,427	100,395
U. S. B. of M. °July 3, 1936	.....	**2,958,000	.....	66,900	105,087

*Estimated Bureau of Mines' basis.

**July, 1936, daily average.

THE Petroleum Engineer

JULY, 1937

Importance of Crankshaft Alignment in Engine Maintenance

Evils arising from crankshaft misalignment emphasize the importance of proper alignment and why it should be maintained—Accurate methods of measuring crankshaft alignment

By ORVILLE ADAMS

KEEPING an engine crankshaft properly aligned is important. The shaft and bearings should be assembled so that there is no springing or deflection; the journal should be supported in its bearings over its entire length. This correct alignment should be maintained by the operator. An engine never should be run with parts not correctly aligned. If for any reason the shaft has been removed, the entire assembly should be checked for level and shaft alignment. The exact condition of the main bearings should be known at all times. This can be determined by inspection, and by measuring and recording the wear at regular intervals. Though this is most conveniently done when the engine is overhauled, it should be done thoroughly at least once a year. The clearance between the shaft and the bearing is measured with a "feeler" or blade gauge. The bearing should not deviate very much from the original clearance at installation. A rule says that the clearance should be about 0.002 in. plus .0005 in. for each in. of shaft diameter.

Maintaining the shaft in perfect alignment will reduce bearing wear and prevent the shaft from bending, avoiding thereby crystallization and subsequent breakage, which always occur sooner or later when bearings are out of line. According to well-understood laws of mechanics, all shafts eventually will break even though the best of care is exercised in keeping them properly aligned; that is, any shaft subjected to combined stresses such as those of a crankshaft will not last indefinitely. In fact, the life of such a shaft can be calculated fairly accurately.

A few cases of broken crankshafts

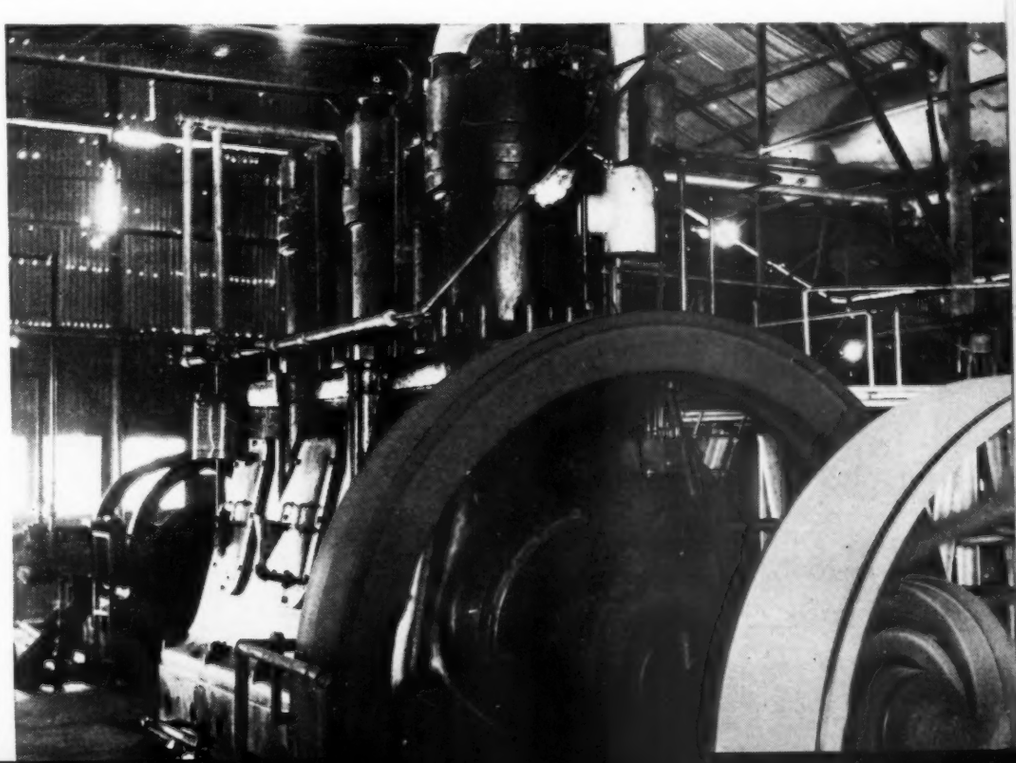


Fig. 1. A 225-hp. 4-cycle air-injection Diesel engine more than 30 years old operating in Tucker Oil Company repressuring plant, Burkburnett, Texas. Engine has just been overhauled and put back in service

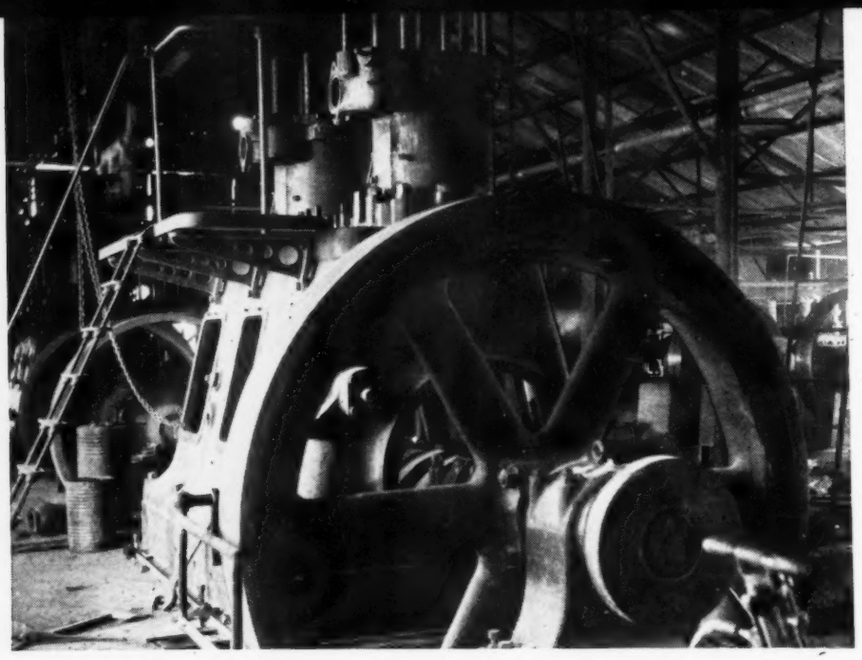


Fig. 2. One of three 225-hp. Diesel engines in Tucker Oil Company repressuring plant, Burkburnett. Engine is just being overhauled and installed

were investigated recently by the writer, one of them of a shaft in an engine that had been operated for almost 30 years. Eventually the shaft fractured, and had to be repaired at considerable cost. It is doubtful if this could be charged to any defect in the shaft or to an operator's carelessness. Fig. 1 shows an engine that has been in operation since about 1912, one of the earliest Diesel engines made in this country by the American Diesel Engine Company, the crankshaft having been made in the Krupp Works, Germany. Fig. 2 shows a similar engine, made a few years earlier, which suffered a broken shaft only recently. Expert examination determined that crystallization had been a long time in progress. Analytical study of the engine in Fig. 1 discloses that hidden breaks may be in progress that eventually will result in complete breakage. Just how long this will take cannot be determined. The two engines, however, provide proof that the deterioration that eventually results in breakage of such shafts is in progress a very long time, the length of time being dependent largely on the degree of misalignment under which they are operated.

The ultimate effect of repeated stresses in shafts should be better known and understood by the practical operating man. The laws that govern the change in the elastic properties and strength of metal brought about by stressing beyond its elastic limit, or *by stressing it repeatedly below its elastic limit,* long have been an interesting and important question in engineering practice. The regular formulas of the mechanics of materials usually are based upon the assumption that the material is homogenous and that the stress is distributed uniformly throughout the material; however, experimental determinations of the average values and ultimate strength of such material as the metal in shafts are based upon tests carried out until failure occurred. The increasing use of materials of this kind under conditions in which they are subjected to repeated stresses of different kinds, as in crankshafts in engines, makes a knowledge of the effect of such stresses of great importance. For example, it long has been known that repeated hardening and annealing seems to strengthen steel and give it higher ultimate strength and elastic limit, hence the practice of heat-treating in the forging process. Experience and experiment have demonstrated that rupture may be caused by a unit stress less than the ultimate strength when the stress is applied a *great number of times in succession.* This repeated stress in crankshafts, evidently produces two definite effects upon the strength of the metal. The first of these is a strengthening effect and may be explained as due to a better adjustment of the particles of the material similar to the effect produced by heat-treating, and likened to the "packing-down" of loose material such as sand

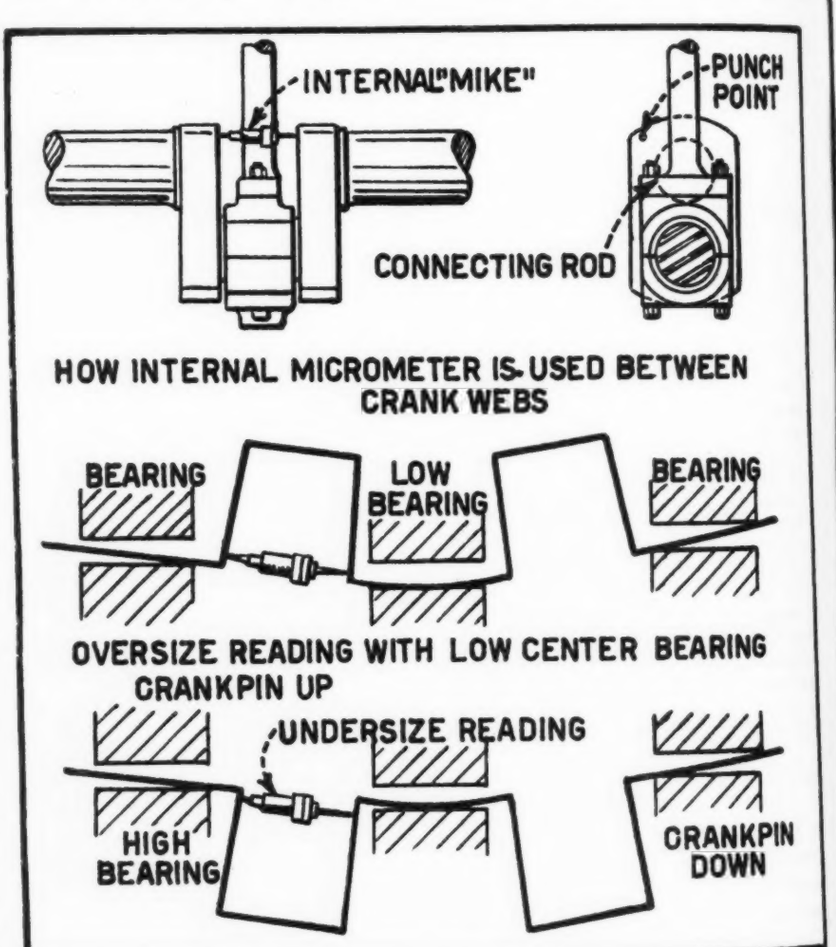


Fig. 3. How an internal micrometer is used between crankwebs to show crankshaft deflection resulting from improper bearing alignment. Diagram is greatly exaggerated

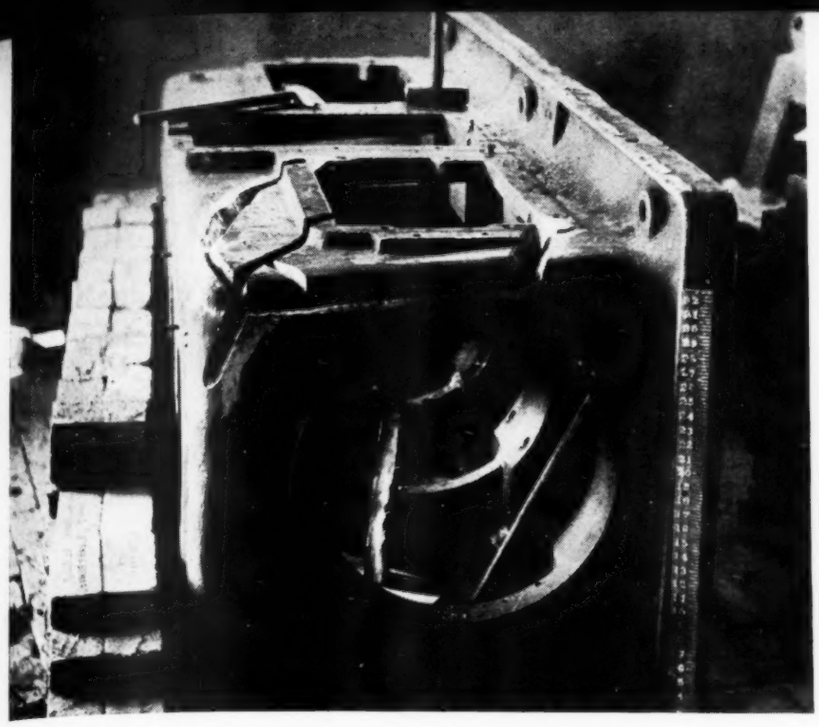


Fig. 4. Broken engine crankcase of gas engine following crankshaft failure. It is veed out and prepared for welding. A preheating furnace is being built around the crankcase

when subjected to a jarring that renders to the mass a greater stability.

Physics teaches that in contrast to this strengthening effect of repeated stresses, there is an observed tendency toward a second effect, which is destructive in the end. It results in rupture occurring eventually at a *unit stress much less than that necessary* before the repeated stresses had been applied. In the crankshafts analytically studied, it has been found that this destructive effect of repeated stresses is without doubt due to the progressive spread of minute fractures, which occur something like minute saw cuts, gradually spreading because of the intensified stress at their edges until the cross-section is reduced to a point that cannot withstand the applied working load, and failure occurs.

All crankshafts are subjected to compound stresses. In addition to the tensile and compressive stresses, there is a shearing stress at each section of a loaded shaft. Tensile and compressive stress have been fairly well determined. Ultimate strengths for shear, and for cases such as crankshafts in which the material is subjected simultaneously or in alternation to more than one type of stress, are not so definitely known. Safe conditions for the operation of such shafts are fixed largely by practical experience.

Out of this practical experience with crankshafts has grown the practice of checking the shaft alignment at regular intervals. Usually the pin gauge is used to determine if the shaft is correctly aligned and running true; but this method is not always accurate. The gauge is fitted between the lower ends of the crank webs with the crank on top center. If the shaft is true, the gauge will fit accurately when the shaft is on bottom center. If loose in the former position the shaft is high at the ends and low in the middle. When it is tight on top and loose at the bottom, the shaft is high in the middle and low at the ends (See Fig. 3).

If realignment of the crankshaft is needed, the usual practice is to level up the bed plate and check the height of the bearings with a straight-edge instrument of some kind. Another way is to stretch a wire through the center of the bearings and gauge the height of the bearing by means of an inside micrometer or pin gauge, whose length should be half the diameter of the shaft less half the diameter of the wire, a slight allowance being made for sagging of the wire.

The center bearings ordinarily wear down a little faster than the end bearings, throwing the end bearings out of alignment—the tolerance of difference between the various bearings are given farther on in this article. Experience with engines has determined that the danger point of bearing wear is approached easily, as will be explained. It is advisable in all instances to keep the bearings as near as possible to the original clearance, and the engine always should be shut down and the necessary work done whenever the wear has exceeded one-half the original clearance if it is at all possible to do so.

The bridge gauge is used to ascertain the distance of the lower half of the bearing below the crankshaft. The crankshaft is pressed down into the shell by two heavy bars placed across it above the bearing, being forced downward by turning the nuts of the studs that project through either end. A smooth piece of lead or other soft material is used under each bar to prevent injury to the shaft. The gauge will show how much the bearing is worn, which should be the difference between the original installation clearance and the distance the shaft is pressed down.

The effect or ultimate result of permitting a shaft to operate out of alignment can be seen in Fig. 4. The shaft was never realigned or checked for several years before the accident occurred. A considerable amount of

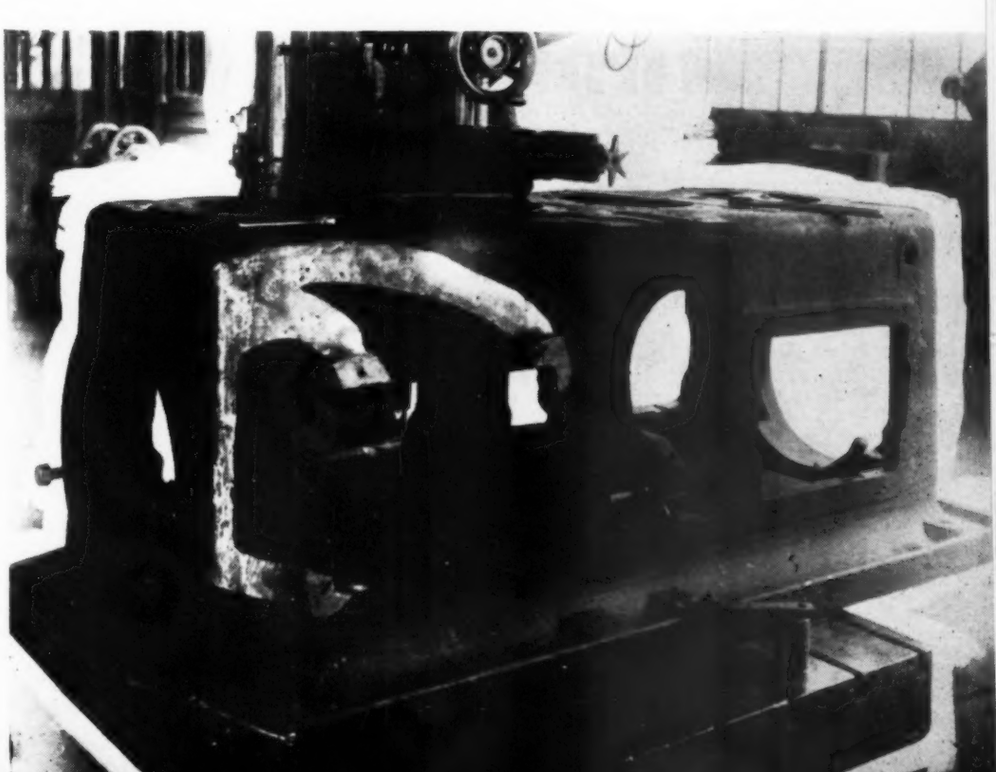


Fig. 5. After welding—crankcase under a shaper for machining the welds

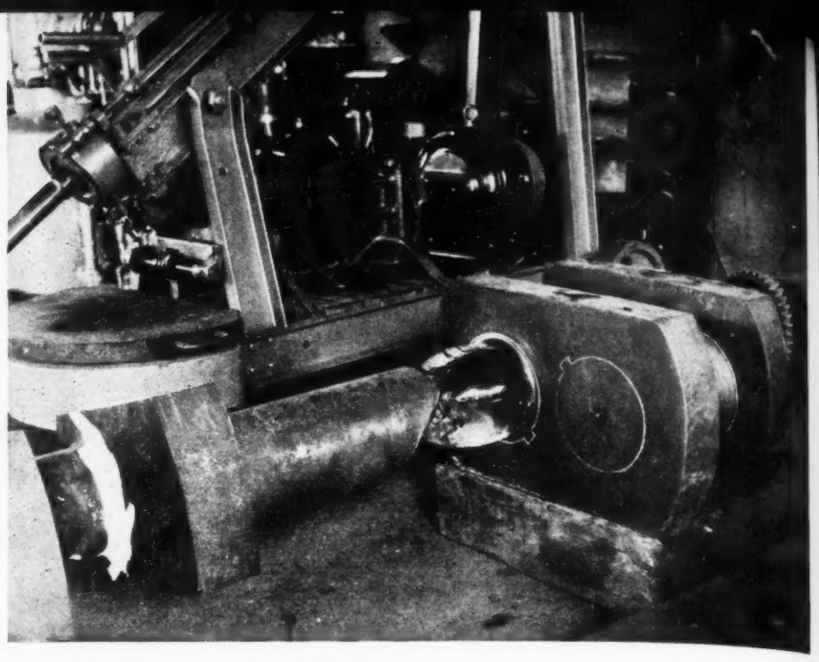


Fig. 6. A very old engine shaft that eventually ruptured in the web

expert welding restored the broken base of the engine, as shown in Fig. 5. Another illustration is shown in Fig. 6, a very old engine shaft that eventually ruptured in the web. The webs of this crank were cut away and new forgings substituted, as shown in the marked journal sections keyed into the webs. When subjected to further analysis additional progressive breaks in the journal were revealed as shown, indicating the usual form of failure in these cases. After many years of operation, fractures developed in many parts of the shaft, and it had to be discarded. Many shafts have been repaired by having new sections, or webs or journals, forged or cast and shrunk on as in a built-up shaft, only to have fractures show up in other sections later on. Once a shaft has failed in any section as a result of progressive crystallization, expert examination should be made to determine if other hidden fractures already have not progressed to the point that the life of other sections may prove to be too short to make repair economical. In the absence of such additional fractures, usually the shaft repair will be economical.

For these reasons, operators should make a detailed study of shaft alignment and the probable result of operating a misaligned shaft. An out-of-round crankshaft journal, or bearing out of line, not only will cause wear, but sometimes may lead to disastrous results. An improperly-fitted bearing that is out-of-round or a misaligned connecting rod operating under stress, is decidedly a potential source of serious breakage. An out-of-round crank bearing that has been tightened too much, and the clearance measured in only one position, will lead to trouble. The tightness of the connecting-rod bolts may be such as to cause them to elongate and rupture, permitting the connecting rod and piston to drop down while in operation. These members if struck by the crankshaft while the engine is under full load and speed, will throw the piston and connecting rod through the side of the engine, not only breaking the engine base and framework, but causing considerable damage to the crankpin, as shown in Fig. 7. It was necessary to weld not only the base of the engine, but to mill off the crankpin, true it up, and use an undersize bearing. While very rare in modern engines, the operator should realize that accidents of this kind are possible, and practically certain in case of prolonged disregard of the shaft alignment, or careless work when fitting up the bearings.

Insurance companies that insure crankshafts require that the shaft and bearings be kept in perfect alignment. In order to pass inspection, all crankshafts, as well as repaired shafts, should meet the following requirements with respect to finishing tests and checking:

1. Axes (center) of journals and crankpins must be parallel with total of .002 in. measured in the length of the crankpin.
2. Variation in axis of any journal from axis of the shaft measured by revolving in V-blocks, shall not exceed .0015 in. measured radially in length of the journal.
3. Axially, center to center, of adjacent cranks plus or minus .015 in., center to center of extreme cranks, plus or minus .030 inch.
4. The angular position of the centers of crankpins plus or minus ½ degree.
5. Radially, distance from center of shaft to center of crankpin plus or minus .010 inch.
6. Diameters of pins and journals plus or minus .002 inch.
7. Pins and journals to be within .002 in. of being round and straight.
8. Journals, pins, and fillets all must be highly polished and all parts requiring accurate tool finish be within the limits of good practice.

A sprung shaft will not measure up to these requirements, hence a shaft of doubtful history must be checked accurately to determine if it is sprung or fails to meet these requirements.

Experience has shown that the above specifications for physical dimensions

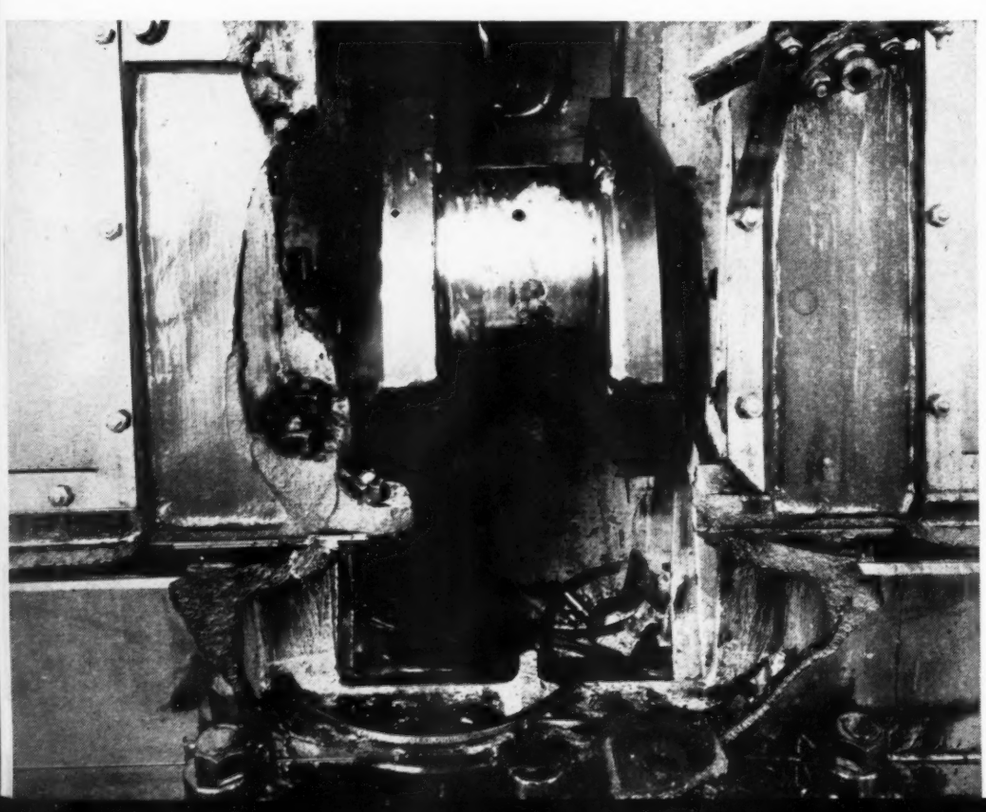


Fig. 7. Close-up of wrecked engine showing scored crankpin. Note the serious damage to the bed plate

will provide a safe and satisfactory shaft. If the shaft does not measure out to meet these specifications, then corrective repair work on the shaft is decidedly advisable.

Analysis of Misalignment

The usual method of checking alignment is to measure the distance between the crank webs at the top and bottom center, as previously described, to determine the amount of shaft misalignment with reference to the main bearings. A variation will indicate that the shaft bends each revolution. If the bending and deformation be appreciable, the resulting stress set up will in time cause crystallization and fracture of the shaft. How long before this occurs will depend on a number of factors that can be determined.

Recently a most reliable method of calculating this stress was developed and announced by the Hartford Steam Boiler Inspection and Insurance Company that makes it possible to determine when shaft deflection has become dangerous. This company recommends the use of a straingauge (Fig. 8) for measuring the distortion of the crank. When the straingauge is placed in position with a sufficient amount of compression on the spring, the pointed rods bear against the inside faces of the crank web with enough pressure to sustain the weight of the straingauge. Two center punch marks are placed on the webs to receive the rod points. The crank is then revolved to four different positions without removing the gauge and the reading of the dial is taken for each position of the crank, namely: the bottom, back, top, and front positions.

The advantage of the straingauge over the usual method is obvious. For effective results, skill and experience in the use of the straingauge are required. When the engineer becomes familiar with it he can detect hazardous conditions, prevent shaft disasters, and eliminate distortion before it has reduced the shaft to a condition of fatigue and breakage, which a continuance of the distortion will certainly bring about if the condition is not remedied in time.

It is not only important to check alignment and reset the shaft to proper alignment, but it has now been recognized that the maximum bend and stress always should be determined and the probable condition of the shaft analyzed. The maximum bend of the crank webs, as cantilever beams, is then the greatest distance found between any two of the four readings taken of each crank. From this the fiber stress in the crank webs can be calculated by means of the usual formula based on Kooke's law. The formula is as follows:

$$F = \frac{43{,}500 \times A \times t}{L^2}$$

in which:

F = Apparent fiber stress in lb./in.^{2}

A = Maximum difference between straingauge reading in two positions, expressed in mils, (1/1000 in.)

t = thickness of the crank web in inches

L = length of crank, or half the engine stroke, in inches

This formula assumes that the entire distortion is taking place in one of the two crank webs, which, of course, is the worst condition that can exist. Actually, however, the distortion of the crank as indicated by the straingauge may be divided between the two crank webs, so the formula intentionally is on the safe side.

The proper and diligent use of this straingauge and accurate analysis of the readings may disclose a dangerous fiber stress. When the apparent fiber stress in the crank webs exceeds 20,000 lb. per sq. in. by this method of investigation, the shaft should be taken out of service immediately and expert inspection made, for it is most reasonable to expect that dangerous progressive cracks already will have developed in the crank webs, in the fillets of the crankpin, or in the fillets of the journal. Such breaks as shown in the illustrations definitely will result if the shaft is continued in service very long after such cracks develop. Methods of inspection have been developed that disclose the presence of such minute cracks, and when discovered it is advisable to retire the shaft from service and avoid the great damage that will accompany a complete shaft failure during service.

It is apparent that crankshafts should be examined regularly and that the use of the straingauge is vitally important for determining dangerous distortion. Engineers and operators of Diesel or other engines should become familiar with such instruments and acquire skill in their use. Likewise, it is conclusive that shafts fracture eventually after long use. The length of time involved will vary directly with the amount of distortion and the time a crankshaft is operated under such conditions. A shaft may be sufficiently misaligned to break within a few months, or it may require a generation, but break it will. The only known method of prolonging the life of such members is constantly to maintain alignment as nearly correct as possible.

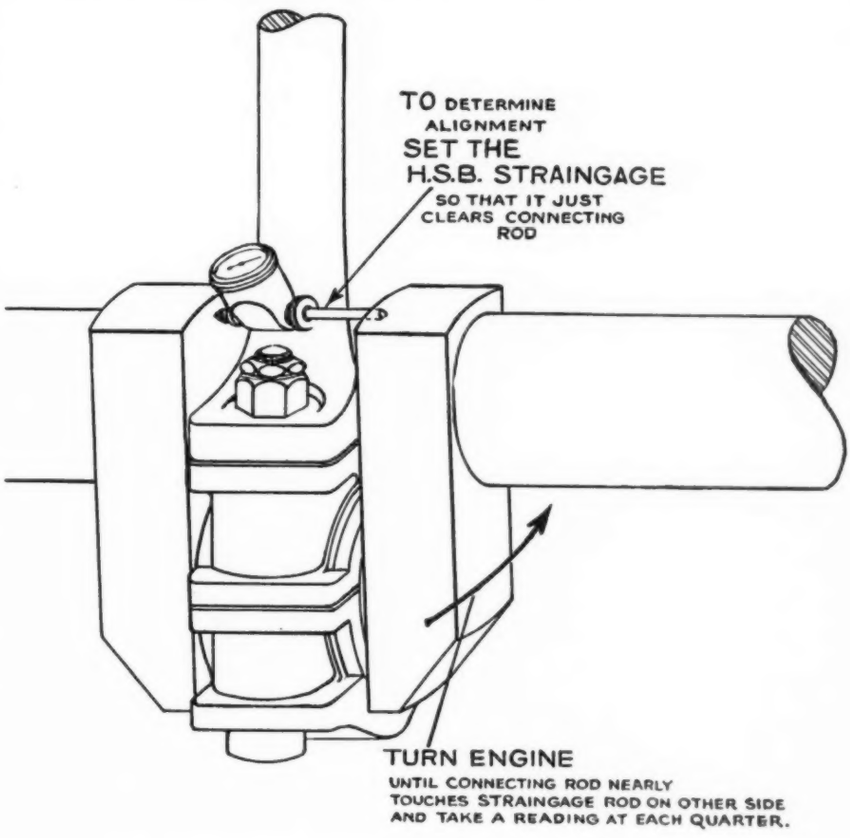
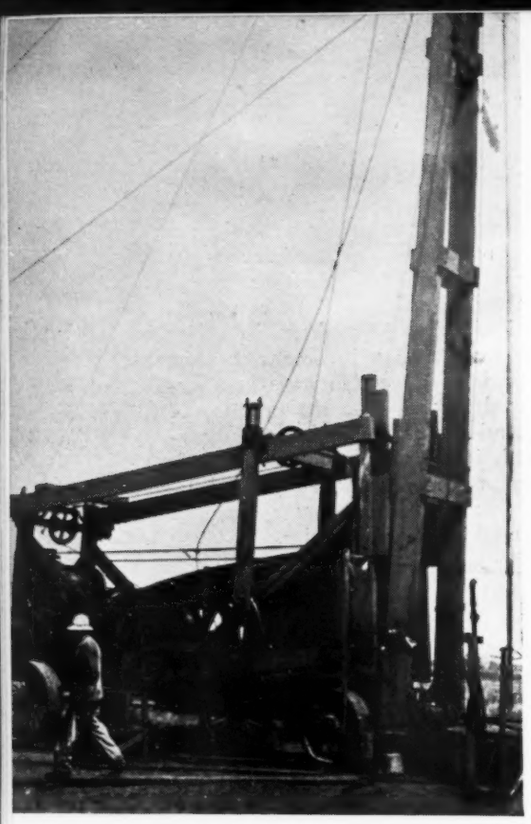

TO DETERMINE ALIGNMENT SET THE H.S.B. STRAINGAGE
SO THAT IT JUST CLEARS CONNECTING ROD
TURN ENGINE
UNTIL CONNECTING ROD NEARLY TOUCHES STRAINGAGE ROD ON OTHER SIDE AND TAKE A READING AT EACH QUARTER.

Fig. 8. Straingauge for measuring the distortion of the crank



Cleaning-out operations on a 2000-ft. stripper well

Cleaning Out Shallow

By K. C. SCLATER

THERE are more than 300,000 wells in the United States that produce only a few barrels of oil daily. Keeping these wells in repair and maintaining their production year after year is a task the very magnitude of which is beyond the scope of the ordinary man to realize. The ability of shallow stripper wells to produce year in and year out has been taken for granted by many in the industry. Comparatively little is known regarding how these wells are enabled to retain their ability to yield so steadily. One probable reason for this is that producing stripper wells is a prosaic operation compared with that involved in modern deep oil field development. It lacks the spectacular performance, equipment, and operation of deep wells of the high-pressure type that arrest attention. Despite the obscure nature of stripper-well operations, great improvements have taken place in recent years in the methods of handling these small shallow wells, both with respect to how they are produced and how they are kept in repair.

Secondary methods of recovery, particularly repressuring with air or gas and water-flooding, have increased the possibilities of so-called stripper fields and given many of them a new lease of life. They now are nurtured more carefully. Records are kept of their performance and their producing characteristics more carefully and systematically studied and analysed than they used to be.

The necessity for keeping wells in good repair is emphasized when secondary recovery methods of production are adopted. A successful secondary recovery project requires that the air, gas, or water be confined to the producing strata. This means that the pay sand or sands should be protected by casing or packers from contamination from or loss through, water-bearing or other strata barren of oil.

Even where no secondary recovery methods are in use it is considered not only essential, but good practice in many shallow stripper well areas to adopt a systematic repair and clean-out program. For this work cable tools are in general use in conjunction with portable rig equipment.

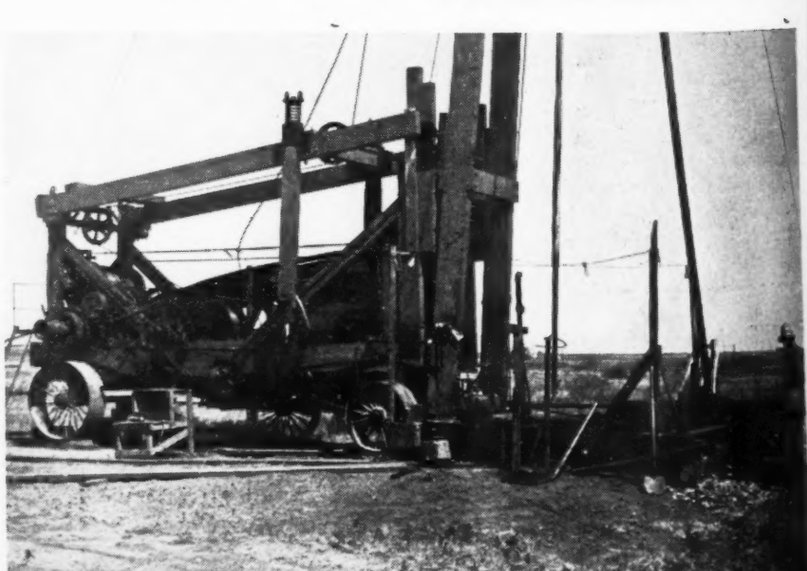
Although the principle of the cable-tool system of drilling has undergone comparatively few changes, great improvements have been made in tools, materials, and equipment. It is the availability of this equipment that has made it possible economically to maintain shallow wells in condition and so prolong their commercially productive life. Large groups of shallow wells today are being maintained at a cost that a few years ago would not have been possible. Not only that, the wells are kept at a higher standard of producing efficiency.

A typical example illustrating these points is found in North Central Texas, an area in which there are many stripper wells. One operator there has 510 stripper wells. They vary in depth from less than 200 ft. to as much as 2000 feet. Most of the wells lie within a radius of ten miles, the remainder being within an 18-mile radius.

Three spudding machines are kept in continuous operation on repair and clean-out work. One is equipped with a calf-wheel and 60-ft. mast, the other two each have a 50-ft. mast and no calf-wheel. The one machine with calf-wheel is found sufficient to handle the wells at which a casing or liner job is involved.

Each machine is driven through a flat-belt drive by a 6-cylinder engine. Fuel for the engine is obtained from a

Close-up at the well head showing tools ready to run-in



Portable rig, or spudding machine, used in cleaning-out operations

Wells With Cable Tools

Following a systematic program and employing modern portable equipment in caring for large groups of stripper wells can result in important economies

low-pressure residue gas line, a full connection being taken from the residue gas line at the most convenient point nearest the well to be worked upon. As the pressure in the residue line is only 10 to 12 lb., a low-pressure regulator is used in the fuel line leading to the engine.

Most of the wells are equipped with $5\frac{3}{16}$-in. casing and a 4-in. shop-perforated liner. A 3-in. string of cable tools is used for clean-out work inside the liner. For cleaning out behind the liner larger bits are used, the size depending upon the diameter of the hole. The string of tools, popularly known as a "macaroni" string because of its small diameter, consists of a 3-in. sinker or stem, a set of jars, and the bit. Usually when working in a hole the condition of which is not known or in which trouble from tools sticking may be anticipated, the jars are used on the lower end of the stem rather than above it. The drilling line is either $\frac{3}{4}$-in. or $\frac{7}{8}$-in. and the sand line $\frac{1}{2}$-in. diameter.

Not more than two days' total time is consumed in moving from one well to another and rigging-up. That means two tours only, as each machine is operated by a driller and a tool dresser, who work daylight tour only.

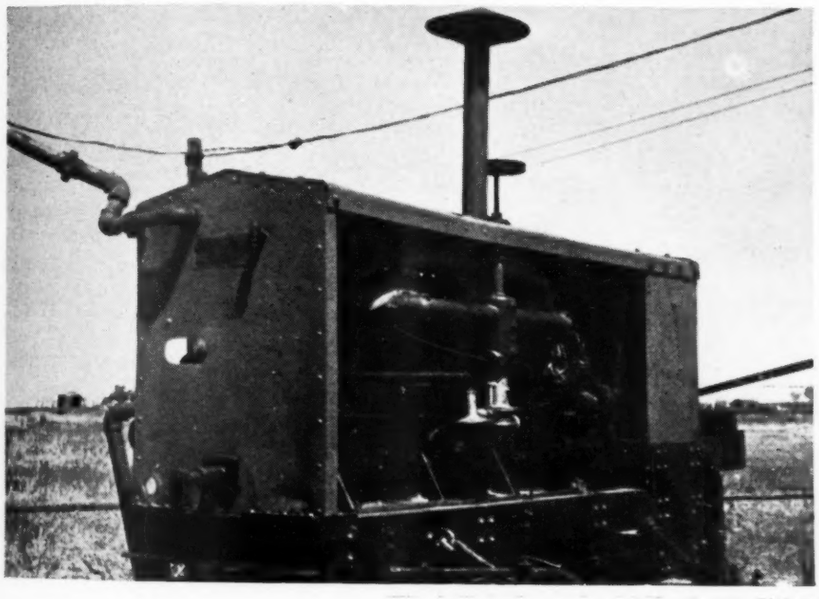
The time occupied on each well varies, but a rough average for the area discussed is ten days—or ten daylight tours. Some wells require cleaning-out more frequently than others. An interval of several years may elapse between repair and clean-out work on some wells. One of the wells shown on accompanying illustration, for example, had not been cleaned-out for six years. By putting a well in proper repair the frequency of clean-out jobs can be reduced materially and also the production maintained at a higher daily rate.

Other than the three portable cable-tool rigs in use, there are no derricks or permanent masts at any one of the 510 wells, whose total production is 1600 bbl. daily. They are all produced by pumping jack from 35 central powers. Each power pumps from 11 to 18 wells, and is powered by a 35-hp. gas engine.

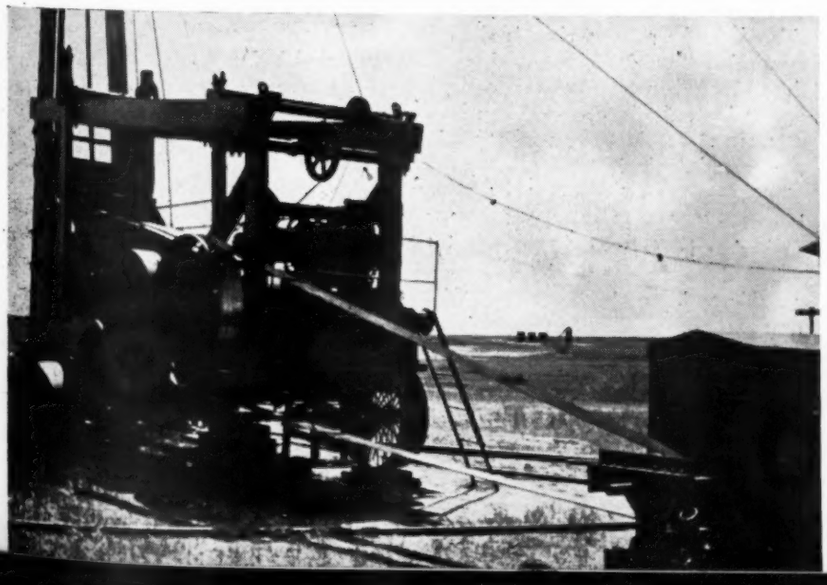
The modern portable equipment used is handled easily by two men. Its use has reduced delays in repair and clean-out operations at wells to the minimum. When it is considered that the average daily production per well is only three barrels daily such economies, though they may seem insignificant, become highly important.

Cable-tools are peculiarly adapted to and therefore are in wide use for this type of work. Without them, many economies now obtained would not be possible.

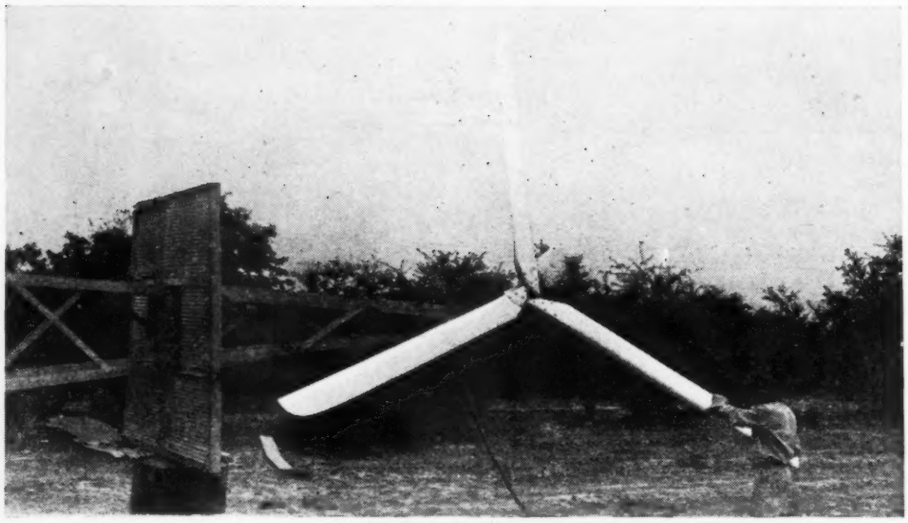
A 4-in. perforated liner is being run in this well



The prime mover, a 6-cylinder gas engine, used to drive the rig



View showing flat-belt drive from engine to rig



Figs. 1 and 2. These two views and Figs. 3 and 4 on following page show steps in erecting a windmill. A United Gas unit in northern Mexico

(Photographs courtesy Branch-Krachy Company, Houston)

By
STARR THAYER
Corrosion Engineer, United Gas Public Service Company

Cathodic Protection of Pipe Lines

This method of protecting pipe lines from corrosion is being more widely used each year and equipment is undergoing constant improvement

CATHODIC protection of pipe lines is being practiced more widely each year and this fact, plus recent improvements to equipment, indicate this method of protecting pipe lines from soil corrosion is well past the experimental stage. Another factor indicative of the importance of cathodic protection is the stress placed on it by the various major companies.

Thus, with cathodic protection established on a firm basis, one of the most important questions to be considered at the present time is the economics of electrically protecting pipe lines. In other words, can cathodic protection units be operated at a lower cost than the old system of replacing the corroded pipe?

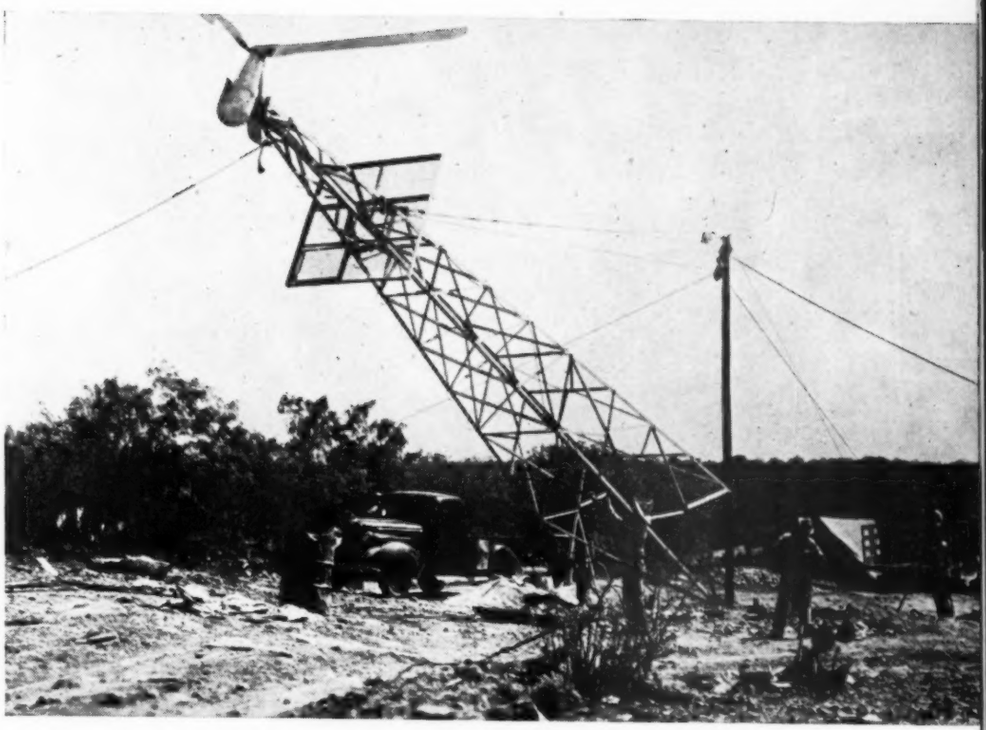
The answer to that question is "yes," but only if each piece of equipment in such a cathodic protection system be operated in the most efficient manner possible and yet obtain the maximum results.

With this thought in mind this article will consider the question of ground-bed resistance and its control, as well as to recount briefly the more important improvements in the wind-driven generator and the gas-engine unit.

Principle of Cathodic Protection

Soil corrosion, an electro-chemical action, occurs when chemical conditions in the soil surrounding a pipe line generate electrical currents that are attracted by the pipe line. When

Fig. 3



the currents leave the pipe line, corrosion takes place. If the potential of the earth surrounding the pipe line is higher than the pipe line itself, the currents of electricity will not leave the pipe and thus corrosion is forestalled. That is the principle of cathodic protection.

A ground bed is installed at some distance from the pipe line and to this ground bed is connected the positive terminal of a source of electrical energy. The negative terminal is attached to the pipe line. In operation, the electrical current enters the earth at the ground bed and returns through the intervening soil to the pipe line. In this manner, the potential of the earth around the pipe line is kept higher than the potential of the pipe line.

To operate a cathodic unit economically, the amount of power used must be kept at a minimum and yet still maintain maximum efficiency. In other words, the amount of voltage used must be kept at its efficient minimum. Control of the voltage can be accomplished only by one method: the regulation of the resistance of the circuit.

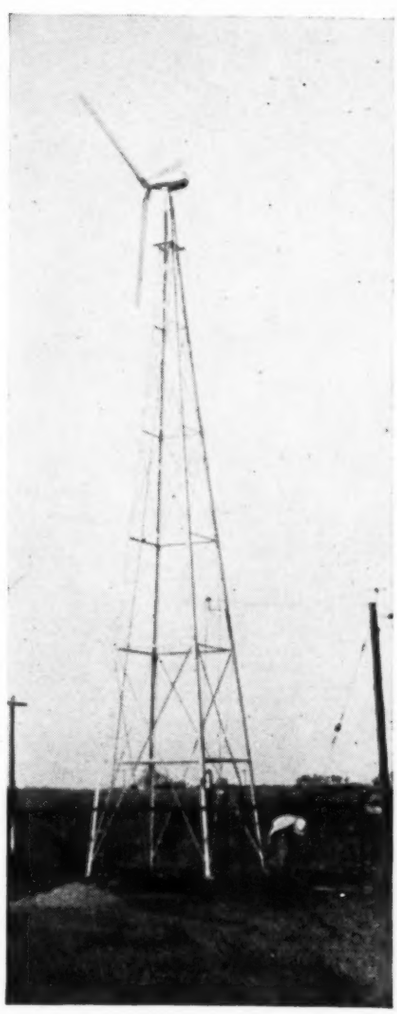
The resistance of the circuit consists of wire, the contact resistance between the ground bed and the soil, and the resistance of the soil in the area between the ground bed and the pipe line. It is apparent that the resistance of the soil in the area between the ground bed and the pipe line can not be controlled, but the wire resistance and the contact resistance between the ground bed and the soil surrounding the ground bed can be controlled.

This contact resistance between the ground bed and the adjacent soil very often is many times greater than the resistance of the copper cable connecting the unit and the ground bed. The greatest loss of energy occurs in overcoming the resistance of the contact between the ground bed and the soil.

Past experience has shown that salt is the controlling factor in the conductivity of a soil, the conductivity depending upon the quantity and the kind of salt present. With this fact in mind, a laboratory experiment was conducted to determine the type of salt most desirable in contact with the ground bed.

In this experiment the salts used were sodium chloride, copper sulphate, calcium chloride, and calcium chloride and acetic acid. The results of the experiment showed that sodium chloride and calcium chloride were the two salts that gave the best results. Either calcium chloride or sodium chloride present in the soil in contact with a ground bed will produce an electromotive force in the same direction as that applied by the unit. This fact will tend to reduce the power required to operate the unit successfully.

Fig. 4



Types of Ground Beds

Of the two types of ground beds, horizontal and vertical, the vertical presents the greater advantages. A vertical ground bed is constructed by sinking a number of vertical pipes in the earth and then connecting the tops of these pipes.

When this type of ground bed was first used, the holes were drilled only to a depth of 12 to 14 feet. Constructed in this manner, the vertical ground bed is very unsatisfactory. Later, the holes for the pipe were drilled with a core-drilling rig equipped with bits of large diameter. This method still is employed.

The holes are drilled deep enough so that the top of the pipes will be at least two ft. below the ground level. To tie the large ground-bed pipes together, 4-in. pipe is welded to the tops, thus connecting all the individual pipes. After the pipe is set in the hole, drilling mud is poured in to fill all the space both inside and outside the pipe. This type of vertical ground bed has proven most satisfactory.

The horizontal ground bed consists of a trench about six ft. deep in which is placed a continuous length of pipe.

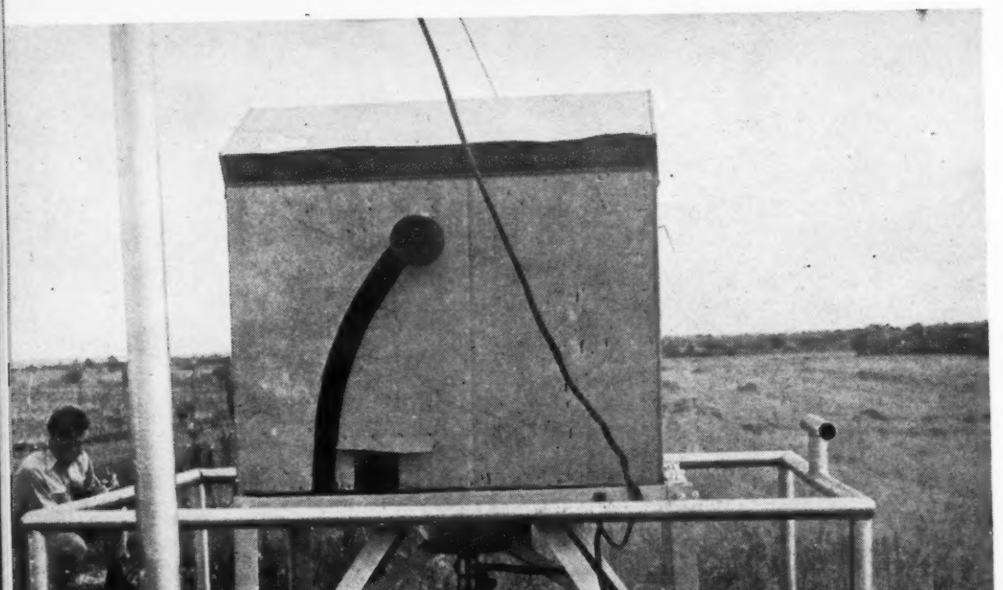


Fig. 5. A gas-engine unit closed

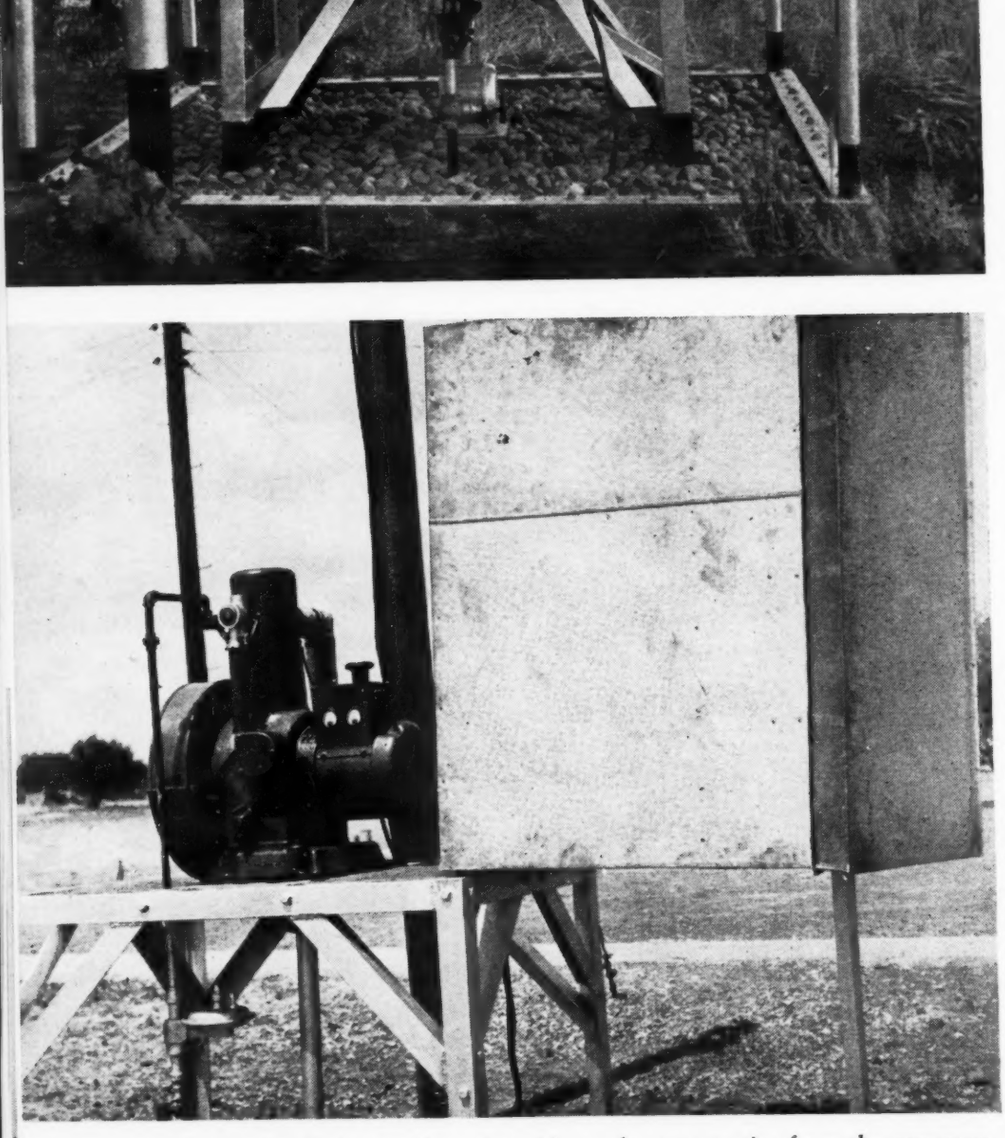


Fig. 6. A gas-engine unit opened

The depth of the trench varies with the local moisture level. Usually, two trenches are dug so that they form a V. At the peak of the V a vertical riser is welded, and to this is connected the copper wire from the generator.

With both the horizontal and the vertical type ground bed, any kind of soluble salt can be mixed thoroughly with the soil surrounding the pipe; however, the addition of a salt to the soil adjacent to the horizontal ground bed is simpler than adding a salt to the soil around a vertical bed.

Too much care can not be taken in selecting the site for a ground bed. Test holes should be drilled and resistance measurements of soil samples made. Preference usually is given to a soil showing the lowest resistance, except in the case of sandy soil and clay—for better results will be obtained from a clay than from a sand, even if the sand shows a lower resistance than the clay.

Cathodic Protection Units

Of the four types of cathodic protection units in use today, only two have been changed appreciably within recent months. The motor generator set and the rectifying unit have remained unchanged, while the wind mill has been redesigned completely and greatly improved, and another cylinder has been added to the gas engine.

Besides the addition of another cylinder to the engine, which burns either gas, gasoline, or kerosene, a magneto has been substituted in the ignition system to supply the power, which heretofore has been derived from the generator.

The new 2-cylinder engine is air-cooled and is fitted with air and gas cleaners and with forced lubrication throughout; however, one of the most important changes and improvements is the elimination of the governor that controlled the speed on the old single-cylinder engine. Replacing the governor is the torque control principle that operates the engine at varying speeds depending upon the load. This flexible feature makes for maximum efficiency at a minimum fuel consumption.

Normally operating between 400 and 900 r. p. m., an automatic overspeed device shuts down the engine when it reaches a speed of 1200 r.p.m., due either to a greatly increased or to a greatly relieved load.

Altogether, this new 2-cylinder engine may be said to operate more smoothly and more reliably than the old single-cylinder model. The fuel consumption is practically the same on the new engine as on the old, despite the fact that another cylinder and a larger crankcase have been added.

The wind mill, driven by a two-bladed propeller and guided by a tail, has been redesigned and rebuilt completely. The new wind mill has a three-bladed propeller mounted at the rear of the machine where it serves both as a propeller and as a tail. The tail was eliminated mainly because it added unnecessary weight to the machine and also it tended to cause vibration.

The three-bladed, variable-pitch propeller permits the machine to start at lower wind velocity and also acts as a control in high winds. Another reason for the addition of a third blade to the propeller is the fact that the use of the wind-driven generator is spreading to sections of the country that in the past have not made use of the machine. The three-bladed propeller handles varying wind conditions better than the two-bladed model. For example, until the early part of the past year, the use of the wind-mill generator was confined mainly to Texas; however, at the present time installations have been made in Mexico, Kansas, Montana, Oklahoma, Arizona, New Mexico, Utah, and Louisiana.

A direct drive between the propeller and the generator on the new machine has replaced the step-up gear found on the old wind mill. As a result of this new direct drive, a slower speed generator is being used that operates between 52 and 240 r.p.m. at which speed the maximum output is obtained. The generators now being used in connection with the wind mill are of two sizes, 20-volts and 80-amp. and 12-volts and 40-amperes. A thermal element protects the generator against shorts, open circuits, and over loads.

Two roller bearings, one mounted a foot below the other, support the turntable on the vertical shaft upon which is mounted the generator. Above the upper bearing are the collector rings that connect the external circuit and the generator. These rings are completely protected against moisture, grease, or dirt, being totally enclosed. A manually-operated friction brake is employed to stop the machine for inspection.

Conclusion

In conclusion, it may be stated that the future will witness efforts aimed at the more economical operation of cathodic protection systems. Minor changes in equipment likely will be made, but for the most part work on the ground-bed angle will accomplish this end.

Fig. 7. A gas-engine unit in south Louisiana mounted to escape flood waters

Fig. 8. Near Wichita Falls, Texas. Showing wind-driven generator and line leading to the ground bed. The pipe line runs along the base of the bluff in the background

The 8-cylinder, 350-hp. Diesel engine used to drive the generator. Note the large radiator for cooling-water set in the wall at the extreme right

Diesel-Electric Power Replaces Gas-Engine Drives When Gas Supply Dwindles

By LEO H. TOWERS

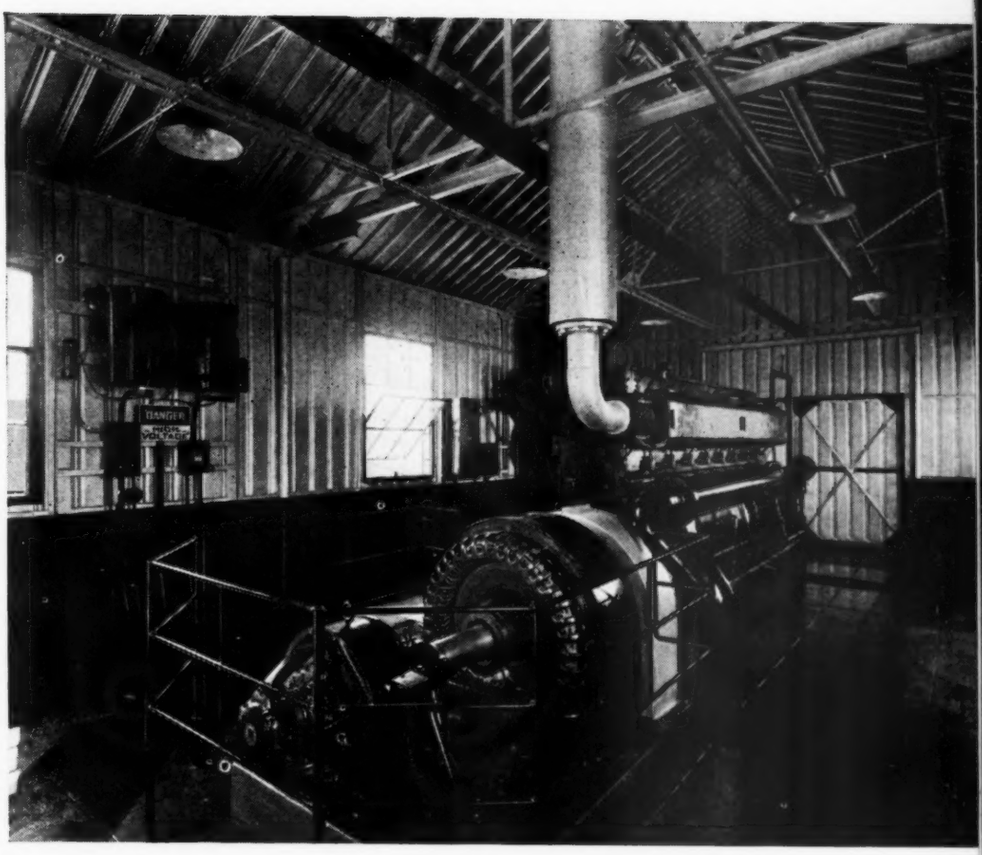
More than 140 wells to be pumped from twelve central powers, power for which will be supplied from power generated on the lease

FACED with a shortage of natural gas, due to the natural decline of the wells, the Continental Oil Company has turned to electric power generated by its own plant to pump economically the wells on its leases near Nocona, Texas. The gas supply in this settled producing area had dwindled to the point that shut-downs became too frequent because of the lack of gas. In all, 142 wells, producing from 7 to 25 bbl. daily, were being pumped by 12 central powers driven by gas engines.

When company engineers decided to replace the gas engines with electric motors only one-half of the field, or six powers pumping 72 wells, was selected for the first installation; however, the power plant was designed to handle the remaining half of the production without any additions. At the present time, with the original installation operating successfully, the remaining half of the pumping equipment is in process of being converted to electric motors.

The power plant building, so situated that the transmission lines to the various powers are of minimum length, is a conventional-type 18-ft. by 36-ft. structure. It houses an 8-cyclinder, 350-hp., 600-r.p.m. Superior Diesel engine—the same as sold by the manufacturers for drilling. Direct-connected to the engine is a 250-kw., 2300-volt generator and a 7½-kw. exciter.

For cooling the engine water a 7-ft. by 10-ft. radiator was installed in a wall section of the building. Behind the radiator a 56-in. fan is driven by a 14-hp. motor. By using a reversible motor on the fan this unit acts as a forced air ventilating system for the building in both summer and winter. In summer air is taken from the inside of the building and forced through the



The generating end of the engine-generator set showing the 250-kw. generator and 7½-kw. exciter

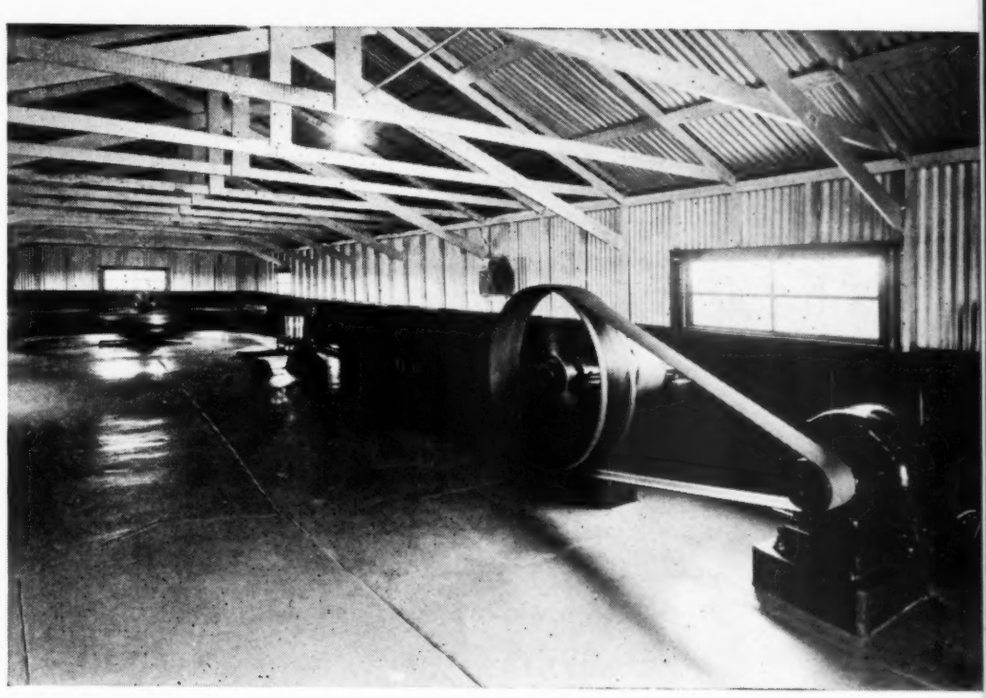
radiator to the outside, causing continuous air circulation. In winter the fan is reversed and outside air, first heated by the water going through the radiator, is forced through the interior of the building. Sufficient heat is obtained in this manner so that no other heating system is required.

A small compressor for starting-air completes the equipment within the building. Outside, two elevated 65-bbl. tanks are used for makeup water and fuel supply. The fuel oil is delivered to the station by tank wagon.

From the power plant to the individual powers approximately three miles of transmission lines were required. These lines carry 2300 volts, with transformers set at each central power.

At the central powers the only change made was the replacing of the gas engines with the electric motors. Three of these powers have 20-hp. motors and the other three 30-hp. motors. As a means of decreasing belt troubles the motors were set on Rockwood bases designed to permit the motor to balance or swing about a shaft in the manner of a lever. The motor rides on the belt and its weight keeps a tension on the belt at all times. This eliminates the necessity of an idler pulley.

At the present time the other six powers are being converted to the electric drive. All motors on this sec-



Interior view of one of the 12 central powers. The motor is mounted on a Rockwood base

ond set of six powers will be of 30-hp. rating. As the power plant originally was designed to care for this additional load the only work necessary, other than that at the central powers, will be to add about four miles of transmission lines.

The original half of the project has been in operation approximately three months but the operating costs or lifting costs per bbl. are not yet available due to other work in progress there at the present time; however, the indications are that the new plan of operation will be economical. No additional help has been required, as operation of the power plant is being handled by the pumpers already employed on the leases. The engine has been equipped with hot-water and low-lube-oil cut-offs, as well as other safety switches to protect the equipment. The only actual operating expenses being incurred at this time are the costs of fuel and lubricating oil. At the present time the engine is using approximately 200 gal. of distillate daily. The plant operates the full 24 hours.

Drilling and Completing World's Deepest Producing Well

Marks the culmination of eight months' careful work during which all the latest engineering practices were brought into play. Completion of this well also established several records among which were successfully landing longest string of 9⅝-in. casing ever run in a well; setting longest string of casing of any size ever run in a well; gun-perforating casing at a depth greater than 12,000 feet. Temperature of only 180 deg. fahr. permitted placing cement successfully without resorting to use of ice for cooling

By DENIS S. SNEIGR

CLIMAXING eight months of drilling operations, several phases of which established records in deep-drilling practice, the Humble Oil and Refining Company on May 20 washed in the No. 1 Ellender—the world's deepest producing well.

Though the No. 1 Ellender is producing from a sand between 11,610-15 ft., the well was drilled to 12,165 feet. A test was made at 12,014 ft. and showed salt water. Plugged back to 11,619 ft., the well originally produced 23 bbl. of 39-gravity oil an hour through ¼-in. choke. At the present time it is producing 12 bbl. an hour through a ¼-in. choke. At the a tubing pressure of 3000 pounds.

This well, in the old Houma gas field in Terrebonne Parish, Louisiana, was spudded September 19, 1936. The casing program follows:

Casing	*Depth*	*Diameter of Hole*
26 -in.	57 ft.	30 in.
20 -in.	260 ft.	25 in.
13⅜-in.	2824 ft.	18½ in.
9⅝-in.	8735 ft.	12¼ in.
7 -in.	12,109 ft.	8⅝ in.

When 8735 ft. of 9⅝-in. casing was set in the No. 1 Ellender a record was established for the longest string of 9⅝-in. casing ever landed successfully. At 8735 ft., the hole was reduced from 12¼ in. to 8⅝ in. and carried on down to 12,165 feet.

At 12,109 ft. the 7-in. casing was cemented. This is the longest string of casing of any size ever to be set in a well. After setting the 7-in., an attempt was made to gun-perforate the casing at 12,014 feet. Here a problem arose: the longest conductor-core cable available was only 12,000 ft. in length; so it was necessary to splice on another length of some 1100 feet. The total length of cable with splice was 13,124 feet. Splicing a line is a procedure the service company doing the gun-perforating would not ordinarily approve of, because it always has used one-piece cores. In this instance, it took a sporting chance in an emergency. Only one shot discharged out of the 12 shots; but it turned out to be sufficient. The resulting pressure was great enough to blow the mud from the hole and it was necessary to resort to the blow-out preventer to close the well in. When the well was shut-in, a pressure of 250 lb. was observed at the casinghead. A column of mud weighing 10.5 lb. per gal. would exert a pressure of more than 6500 lb. per sq. in. at 12,014 ft., the point the casing was perforated. This gives one an idea of the magnitude of the bottom-hole pressure at this depth.

On the second attempt to perforate the casing between 12,013-18 ft., the gun was run in the hole under pressure. Ten out of 12 shots fired and the well showed salt water.

The Humble then plugged back to 11,649 ft. and perforated the casing between 11,620-30 feet. On this test, the well showed oil and salt water, and the pressure on the casing was 5200 pounds. Following this, the operators used a cement squeeze job and plugged back to 11,619 feet. The casing was perforated between 11,610 and 11,615 ft. with nine shots and the well brought in as a commercial producer.

Before the well came in, however, 11,524 ft. of 2⅞-in. drill pipe was run into the hole to serve as tubing. No screen was set.

The perforation jobs referred to established a depth record for successful operation. Shooting between 12,013 and 12,018 ft. is the deepest yet recorded and, to say the least, is a signal achievement.

In drilling the world's deepest producing well, the heaviest equipment available was used. Listed below are the sizes of the more important pieces of heavy-duty equipment used in drilling this well:

One 14-in. by 14-in. engine

Three 125-hp. boilers

One 15-in. by 7¾-in. by 20-in. slush pump

One 12-in. by 6-in. by 16-in. slush pump

One 7-in. by 4½-in. by 10-in. feed-water pump

One 10-in. by 6-in. by 12-in. feed-water pump.

Though eight months elapsed from the time No. 1 Ellender was spudded until it was completed, the actual drilling time was considerably less. The time mentioned included several straight-hole surveys, three electrical-logging surveys, the taking of approximately 750 cores, and a sidetracking job.

The sidetracking job followed several unsuccessful attempts to recover a stuck drill stem at 8750 feet. The hole was plugged back to 7300 ft. and sidetracked at about 7314 feet. The final straight-hole survey showed No. 1 Ellender to be off vertical three degrees, which is an unusually good record when the depth of the hole and the fact that the hole was deflected at 7300 ft. are taken into consideration.

Another interesting fact in connection with this well was the comparatively low temperature of 180 deg. fahr. found on bottom when the production string was set. Approximately 24 hours was required to run and set the casing and no ice was needed to cool the water for cementing.

Mud weighing 10 lb. per gal. was used from 2824 ft. to 10,000 ft., and the weight was increased from 10,000 ft. until a 12-lb. mud was being used at the total depth.

Although No. 1 Ellender, at the present time, has the title of being the world's deepest producing well, it can be considered but one of a series of wells that during the past few years have been drilled deeper and deeper. Heavier and improved equipment, plus the experience gained through previous deep tests, enabled engineers successfully to complete No. 1 Ellender; and, perhaps, the fact that deep production was found on the old Houma structure may lead to other deep exploratory wells in similar old fields.

Past History a Valuable Guide in Oil Pipe-Line Station Design

By W. H. STUEVE*

A study, based on records of typical installations, reveals valuable information is available to the designer in estimating the cost of electric power and how much electric energy a station will consume

IN the past many stories have been written for oil trade publications concerning the use of electric power for the operation of oil pipe line stations, showing the type of motors and pumps installed, the station floor plans, details of station wiring, and other construction details, all of which data are informative and of great value to design engineers; but the most important information, which would be of value to the design engineer, is never mentioned. The reason is that this important information probably can not be obtained, or definite predictions for the future can not be made, and, therefore, the writer feels that the pipe line design engineer at this time should be interested in reviewing past accomplishments of typical pipe line stations, from which desirable information could be obtained.

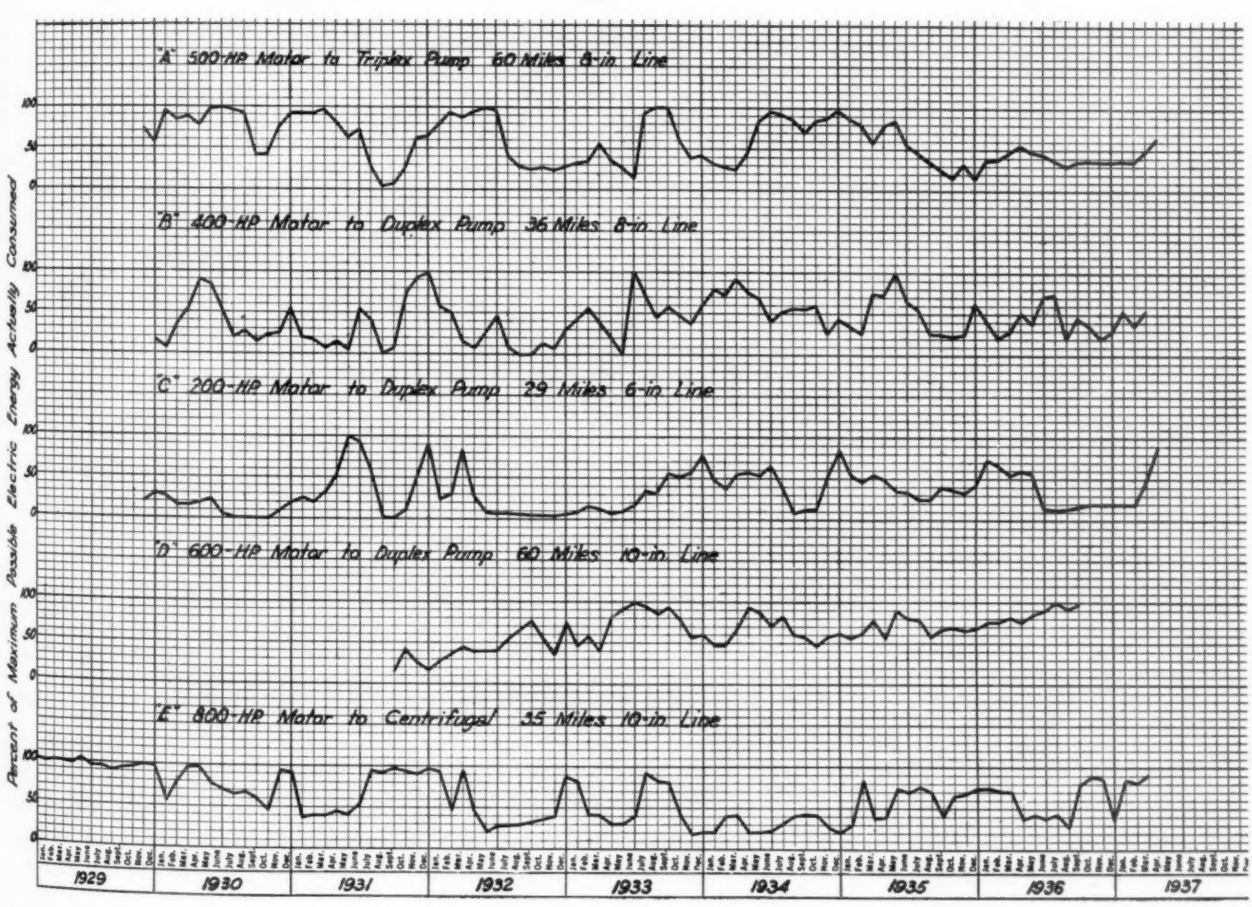
This most important information that the designer of electric-motor-driven pump stations can not determine definitely, is: "What will be the cost of electric power and how much electric energy will the station consume?"

Executives of the contemplated pipe line always are eager to believe that the line will operate to full capacity, year after year, and their optimism is passed along and usually accepted by the design engineer, with the result that operating costs are predicated on this optimistic assumption of continuous operation at high-capacity factors.

Evidence of this optimism on the part of designers of pipe lines is revealed, in the face of refuting history available, from an analysis of the actual amount of oil transported each year by all pipe lines in the United States, as disclosed by reports made by these same pipe line companies, or other companies in similar business, to the Interstate Commerce Commission in Washington. Briefly, these reports summarized show an overall capacity factor achieved by all the "main trunk

*Oklahoma Gas and Electric Company, Oklahoma City, Oklahoma.

Fig. 1



lines" of only about 40 percent annually; further, the capacity factor of "gathering lines" is only about 20 percent annually, when all factors of miles of lines of installed pipe and diameters of such pipe lines are taken into account, together with the volume of oil produced in this country that has to be transported somewhere.

Electric-motor-driven pipe line pumps have been in use by various companies for some ten or twelve years, and it is now possible to refer to records of certain utilities serving the oil industry, to obtain definite and certain data on the amount of energy purchased at individual pump stations for the preceding years to show the wide variation in pumping capacity actually achieved.

The pump stations chosen for this study are selected at random from the files, giving consideration to pump stations installed in main trunk lines, and also to pump stations installed in so-called semi-trunk lines, or gathering stations. The energy purchased in kw-hr. is plotted horizontally in terms of percentage of maximum energy required to pump at maximum design capacity for each month of the years these stations have been installed. This variation in energy consumed is graphically illustrated in Fig. 1, for the following pipe line stations:

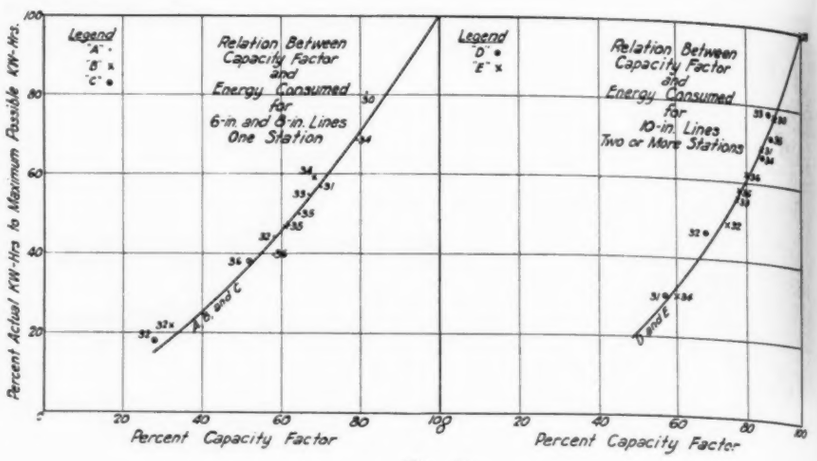


Fig. 2

TABLE I
EQUIPMENT AND CAPACITY OF PIPE-LINE STATIONS STUDIED

Station	Type of Equipment Installed	Total Capacity bbl./day	Line Diameter	Miles of Line Pumped Through
"A"	One 500-hp. to 6-in. x 24-in. Triplex	25,000	8-in.	60 and 30
"B"	Two 200-hp. to 5-in. x 24-in Duplex	22,000	8-in.	36
"C"	One 200-hp. to 5-in. x 24-in. Duplex	12,500	6-in.	29
"D"	Two 300-hp. to 6-in. x 24-in. Duplex	36,000	10-in.	60 and 190
"E"	Two 400-hp. to Centrifugal Pump	40,000	10-in.	35 and 70

Referring to Fig. 1, the energy consumed each month being graphically represented for the five typical pump stations listed in Table 1, note the wide variation in energy consumed for the periods of seven to eight years.

The graphs for "A", "B", and "C", represent pump stations installed to serve a newly-discovered oil field, and can be termed semi-trunk line stations, or large gathering pump stations, while the graphs for "D" and "E" represent pump stations installed on a strictly so-called trunk line.

There does not seem to be any appreciable difference in percentage of the average energy purchases by the year for the seven or eight years, distinguishable as between the two types of pump stations (gathering or trunk line) except that the trunk line stations seem to use the energy more consistently month to month. The graphs seem to indicate that the variations, in electric energy requirements of the five pump stations, are controlled more by market demand for the refined products than by the flush condition of the oil pools served by the pipe lines.

The information disclosed by the graphs in Fig. 1, showing the relation between the actual electric energy consumed and the maximum possible amount of electric energy that the station could take when operating at 100 percent capacity factor expressed in percent, does not necessarily mean much to the casual reader unless it is analyzed further to determine the actual amount of oil transported when a definite amount of electric energy is purchased.

These calculations have been made and the results carefully checked with the individual company owning the pump stations, shown in Fig. 1, with the idea in view of determining the relation between the electric energy actually consumed, expressed in percent of maximum possible takings, and the capacity factor of the line expressed in percent of maximum possible capacity. This relation is shown in Fig. 2, where percent capacity factor is plotted horizontally, and percent electric energy consumed is plotted vertically.

Referring to Fig. 2, note that the calculations from the gathering line stations, are plotted, to make the curve "A", "B", and "C"; whereas, the calculations from the trunk line stations are plotted to make another curve, "D" and "E".

The points for the curves shown in Fig. 2, were developed by using annual totals of actual energy purchased and annual total of bbl. of oil pumped for each calendar year, all expressed in percentage of maximum.

An equation for the curve "A", "B", and "C", in Fig. 2, covering pumping performed in 6-in. and 8-in. lines, can be written somewhat as follows:

(a) Percent of maximum kw-hr. = percent capacity factor raised to 1.5 power.

Similarly an equation for curve "D" and "E", covering pumping performed in 10-in. lines, can be written somewhat as follows:

(b) Percent of maximum kw-hr. = percent capacity factor raised to 2.2 power.

These equations (a) and (b) also seem to hold true when specific months are selected from the data given in Fig. 1.

No particularly good reason can be assigned to explain the discrepancy between the two curves shown in Fig. 2—"A, B, and C", and "D and E", except that on the face of known information concerning the capacities of these lines the divergence appears obvious when the pipe diameters of the lines are considered. Another viewpoint, however, may be that the capacity factor of a given pipe line containing two or more pump stations, as is the case with the data shown for stations "D" and "E", is greater when considered on an annual basis, because of the flexibility of station pumping control of volume, than is the annual capacity factor of single stations pumping through compara-

STOP POWER LOSS AT THE RING JOINT

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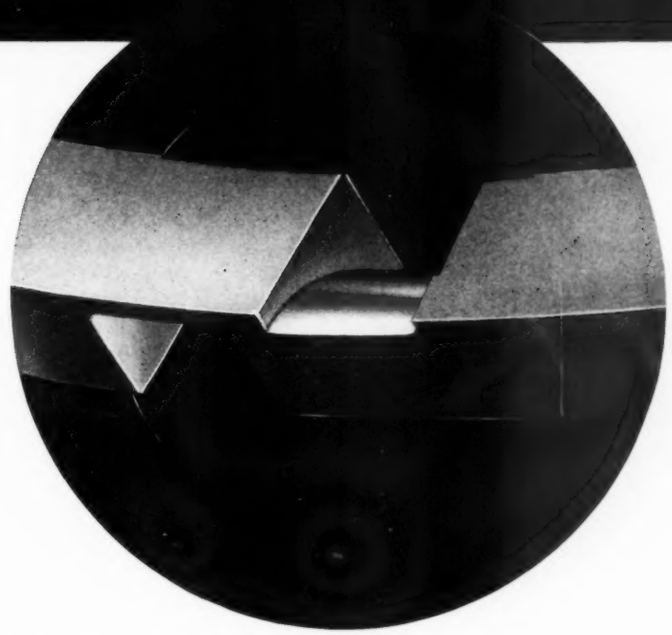

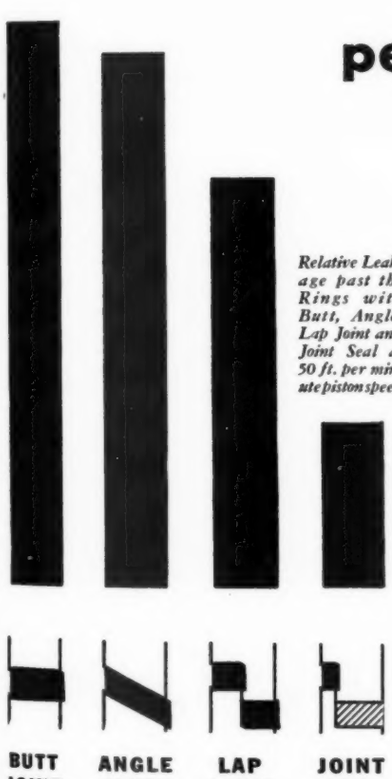

Relative Leakage past the Rings with Butt, Angle, Lap Joint and Joint Seal at 50 ft. per minute piston speed

permanently seal the joint for the life of the ring!

"IF you can stop power leakage at the joint you've done the trick!"

How often have you heard industrial engineers say that? And how frequently have you found that power continually leaks past the joint in butt joint, angle joint, and lap joint rings?

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In the Joint Seal construction, the face of the ring is sealed off at the joint to complete the cylinder seal; likewise, the joint at the groove is sealed off against the piston land. Thus, gas entering the clearance space behind the ring is trapped and cannot escape at the joint.

Remember—wear of rings or cylinders causes greater joint opening. But with Joint Seal Rings the large sealing area maintains the seal as when the rings were installed. Result: more power and continued, efficient engine performance. Insist on Joint Seal Rings.

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TABLE 2
OVERALL PERCENT ELECTRIC ENERGY PURCHASED
and
PERCENT CAPACITY OF PIPE LINES "A", "B", "C", "D", AND "E"

Station Designation	Total Elapsed Time in Years	Average Percent of Possible Maximum Electric Requirements	Weighted Average Computed Percent Capacity Factor
"A"	7½	58.4	70
"B"	7⅓	42.8	60
"C"	7½	32.5	48
"D"	5	66.4	83
"E"	8⅓	62.5	81

tively short pipe lines, as those shown in Fig. 1 as "A", "B", and "C".

As already stated, this discussion so far deals only with electric energy purchased, but Table 2 is presented in order to make the discussion more complete and of some value to the pipe-line engineer in making predictions for the future; also to show how fallacious is the theory that assumes all pipe lines of whatever type operate at high capacities year after year. Table 2 shows the actual total amount of oil transported, in terms of capacity factor, by the pump stations listed in Fig. 1, based on computations from curves in Fig. 2 for the total number of years the stations have been installed.

In reviewing the averages from Table 2, the evidence is striking with regard to the relatively small use actually made at all pump stations of the maximum power equipment installed. It leads one to believe that in meeting pumping demands through the years the most economical use possible is made of purchased energy, in keeping with good operating practices.

Up to this point, the results of the study are significant in that it is now possible for the pipe-line designer to know exactly how much electric energy is necessary in order to pump certain given quantities of oil under the most economical conditions; further, the results show that most pipe lines do not operate at 100 percent capacity factor over a period of years, whether the pipe line be a main trunk line or a gathering line.

What has this relation between electric power required and available installed capacity utilized to do with pipe-line design? Simply this: If the station installed represents a certain investment cost, and over a given period of years only 32 to 66 percent (see Table 2) of the available horsepower is utilized, it would seem to behoove the designer, in the first instance, to seek the cheapest form of prime mover and pumps commensurate with good engineering practice and thereby lower the fixed-charge portion of the operating expense.

This reduction in first cost of pump station can be accomplished if the necessary care is exercised by the designer in selecting the proper type of equipment with due regard to capacity factor. If the pump station being installed is contemplated for a main trunk system, and continuity of delivery is essential, then a standby or auxiliary unit of one-half the total capacity would be deemed necessary.

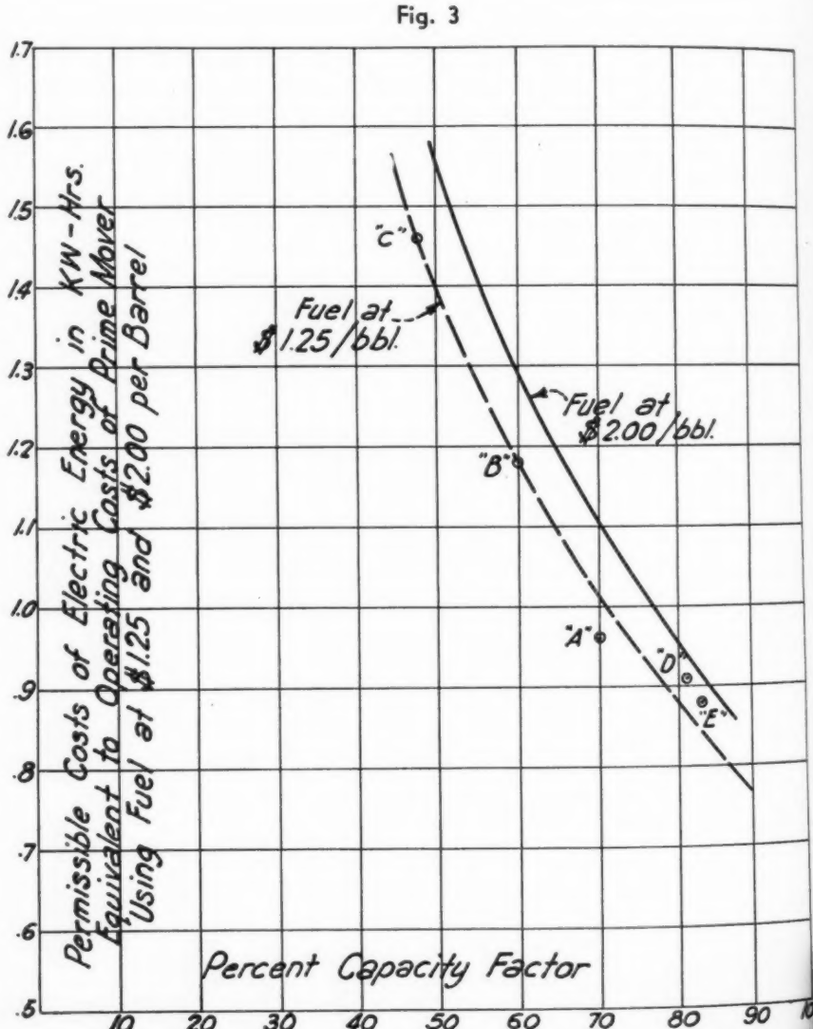
Estimates gathered from numerous contractors indicate that the minimum cost of installing a gathering or semi-trunk line station, without standby units, is approximately $2.00 a bbl. per day of maximum capacity when electric motors are used as prime movers. This figure is for lines of 6-in. and 8-in. diameter. In the case of main trunk line station design, where standby units are considered, the minimum cost for installing a station equipped with electric motors as prime movers is approximately $1.75 a bbl. of daily maximum capacity for lines of 8-in., 10-in., and 12-in. diameter.

Pumping costs consist not only of fuel and lubricating costs, but also such pertinent costs as fixed charges on the investment. Maintenance costs also should be considered and properly determined; likewise, necessary operating labor for the type of station installed should be given careful consideration.

Frequently, little or no consideration is given to the possibility of variations in capacity factor of the line for the present or for the future, with the result that false conclusions are reached on which are based the selection of the type of prime mover and its first cost. In order to bring out the importance of this point, let it be

(Continued on Page 48)

Fig. 3



11,700' OF 2⅞" OD DRILL PIPE

RUN IN AGAINST 50# to 900# PRESSURE

LEAVES CAMERON SELF-FEEDING RAM PACKERS HOLDING PERFECTLY!

CONCLUSIVE PROOF of the rugged durability of Cameron Self-feeding Ram Packing Elements was provided recently when 11,700 feet of 2⅞" O.D. drill pipe was run in a deep well against surface pressures varying from 250 to 1250 pounds when shut-in, and from 50 to 900 pounds when bled off. Running of the drill pipe against pressure was made essential by a surface pressure of 250 pounds which built up immediately after perforation of the oil string at 12,014 feet.

The control hook-up used to handle the job is shown to the left. From bottom to top, the units are: (1) a nested type combination Braden and tubing head; (2) a 7"—5000 pounds test Cameron Pressure Operated Gate Valve; (3) a 7"—5000 pounds test Cameron Type RL Manually Operated Blowout Preventer; (4) a flanged space nipple; (5) a second 7"—5000 pounds test Cameron Type RL Manually Operated Blowout Preventer.

In the course of running this long string, the tool joints on the 30-foot lengths of drill pipe were passed by alternately opening and closing the rams of the upper and lower preventers. The brunt of the wear occasioned by running the drill pipe through the closed rams was absorbed on the packing elements of the upper preventer; rams of the lower preventer were closed only to permit passing tool joints through the open rams of the upper preventer. *Rams of both preventers were opened and closed approximately 390 times. The ram packing in each preventer held perfectly; no change of packing elements was required; and when the job was completed, the packing elements in both preventers showed but little wear.*

In view of the abnormal bottom hole pressure, calculated to be between 6800 and 6900 pounds, an excess of 1200 to 1300 pounds above the normal anticipated bottom hole pressure of 5600 pounds, the Cameron Pressure Operated Master Gate Valve was installed so that should surface pressures become dangerously high the pipe string could be landed on a tapered hanger in the tubing head, the landing joint backed out and the master gate valve closed. It was not necessary to resort to this expedient, since full control was easily maintained at all times.

Safe, positive and dependable control of the kind provided by Cameron Blowout Preventers and Gate Valves on this well is available to operators in all high pressure areas throughout the world. Complete details pertaining to Cameron drilling and completion control units will gladly be provided on request to any interested company or individual.

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LOUISIANA: Pelican Well Tool & Supply Company
OKLAHOMA and KANSAS: Carson Machine & Supply Co.
MEXICO: J. W. Allen, Apdo. 542, Tampico, Tamps.

(Continued from Page 44)

assumed that the contemplated pump stations would be installed and never operated; certainly the charges against this station would not be $0.00, there would be charges consisting of interest and depreciation, taxes and insurance, at some predetermined rate on the investment, even if the station were sealed and boarded up. Under the hypothesis of the saving in first cost of the proposed pump station, considering electric motors, fixed charges must be given consideration, and if 10-year depreciation is equitable for the gathering station and 20-year depreciation for the trunk line station, a total of 18 percent and 13 percent respectively would be equitable for annual fixed charges, including interest at five percent and taxes and insurance at three percent. Assuming that the operating maintenance, labor, etc., would be the same regardless of the type of station, and that the horsepower load is in direct proportion to the maximum capacity desired in design, it may then be said that the pipe line company could afford to pay 18 percent or 13 percent per year on the difference in the first cost of the pump stations. Thus, in the case of the gathering station, the amount that could be paid at zero percent capacity factor per year would be 18 percent (on $4.00 less $2.00), or 36 cents per bbl. of daily maximum design capacity, and in the case of the main trunk station 13 percent (on $5.25 less $1.75), or 44 cents per bbl. of daily maximum design capacity. An average of 40 cents per bbl. of daily maximum design capacity, for zero percent capacity factor per year, therefore, would seem reasonable for pumping stations of both types, gathering and trunk line. Assuming, however, that the pumping station should be put into operation, the equivalent fuel costs necessarily would have to be added to the fixed-charge item in order to obtain the total worth of purchased electric power.

The method just discussed of determining the worth of electric energy actually is in use today, except that it is couched in simple electrical terms.

It is of great aid to the engineer on pipe-line design to know what are the permissible electric power costs that would be equivalent to other types of prime mover operation when average fuel oil prices are assumed. On Table 3 are shown several estimates of such permissible costs.

TABLE 3
DETERMINATION OF PERMISSIBLE ELECTRIC POWER COSTS EQUIVALENT TO OPERATION OF PRIME MOVER USING FUEL AT $1.25 PER BBL.

Reference Table 1 Pump Station	Percent Usage of Maximum Electric Capacity	Annual Average Energy Required Kw-hr.	Annual Average Cost of Pumping with Prime Mover Using Fuel at $1.25/Bbl.	Reference Table 2 Average Capacity Factor of Stations for Total Elapsed Time	Permissible Cost in Cents per Kw-hr. for Power Required
A	58.4	1,530,000	$14,600	70	.96
B	42.8	1,000,000	11,800	60	1.18
C	32.8	432,000	6,320	48	1.46
D	66.4	2,500,000	21,900	83	.88
E	62.5	*2,620,000	25,600	81	.91

*Referred to Plunger Pumps.

In arriving at the permissible cost of electric energy, shown in the last column of Table 3, the price of fuel oil assumed was $1.25 per barrel, the average market value of crude oil during the period 1929 to 1936 (one-half pound of fuel oil is assumed to be capable of producing one b.hp-hr.); also, the electric energy required, shown in kw-hr., was converted to b.hp-hr., after assuming the average efficiency of electric motors as 90 percent.

Fig. 3 shows annual average percent capacity factor plotted against cents per kw-hr. that the pipe line company could afford to pay for all conditions of oil transported, equivalent to values of fuel oil or crude used for fuel at $1.25 and $2.00 per bbl., respectively. Intermediate selected values of fuel may be found by interpolation.

Assuming — as experience actually shows—that the average gathering line station or main trunk line station never operates in excess of 70 or 80 percent capacity factor, over a period of time, and that electric power can be purchased for nine or ten mills per kw-hr. (average for the year), and provided the price of fuel oil does not fall below $1.00 a barrel, the question of the most economical type of prime mover is one that demands the closest consideration if a wise selection is to be made.

Designers of pipe lines should not overlook studying the past history of existing pipe lines; the valuable lessons that may be learned can be applied to the solution of immediate problems that involve predicting future operations, upon which the prudent selection of pumping equipment and prime movers is based.

SUMMARY

This brief but pertinent study of pipe line station design with respect to the average capacity factor of operations, discloses that:

(1) Any class of pipe line does not operate at 100-percent capacity over a given period of years.

(2) If closely predicted when the station is designed, the capacity factor achieved will have an important bearing on reducing pipe-line station charges and operating costs.

(3) There is a definite relationship between capacity factor of any pipe line and the amount of electric power required at such operating capacity.

(4) If the operating capacity factor of the proposed pipe line can not be predicted, a large element of gamble enters into the selection of the prime mover, and the subsequent economy of operation.

A Speed Pipe Wrench

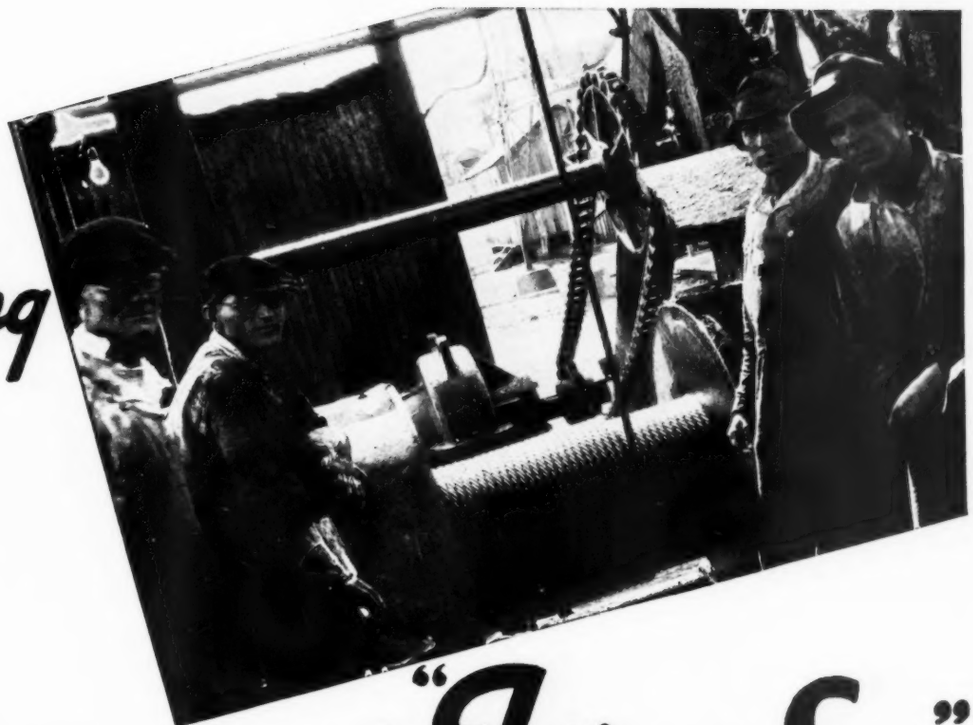
By W. J. GRISSETT[1]

A ROLLER handle fastened at right angles to the side of a small pipe wrench handle makes a speedy tool for "rolling up slack" while laying small pipe. The simplest and best method of attaching the roller to the pipe wrench handle is by inserting the roller axle (a machine bolt) through a hole drilled in the wrench handle. Placing a nut or the bolt on each side of the wrench handle, to lock bolt or axle in place, will leave the roller free to rotate. A small pipe nipple can be used for a makeshift roller.

By changing the roller handle to the opposite side of the wrench handle, the wrench can be used also to unscrew pipe.

It will be found that pipe can be rolled up farther, easier, and faster with this wrench than by hand.

[1]Big Lake Oil Company, Texon, Texas.



this Drilling Crew says

Williamsport "Form-Set" is a better rotary line!

These boys do a lot of drilling and they've tried a lot of lines. When they say a line is good, you can rely on it. And they claim Williamsport "Form-Set" wire line, like you see in the picture, "stands the gaff on rotary drilling better than any other line . ."

And there's every reason to agree with this estimate of the perfect *pre*formed line. Every wire in this line is drawn precisely uniform, through Williamsport's unvarying Carboloy dies. The line is prelubricated with a permanent compound available only through Williamsport and it's tested and certified with Telfax Tape, for your protection. Every inch is built right in our own plant by men and machines building wire lines and *nothing else.* No wonder good drillers come to depend on "Form-Set," Williamsport's *pre*formed wire line.

Rugged, tough, yet easier to handle, "Form-Set" belongs on your rotary job. Priced the same as all *pre*formed line, it often figures less cost by doing more work. For best results, good drillers use Purple Strand "Form-Set."

WILLIAMSPORT WIRE ROPE CO.

Williamsport, Pennsylvania — 122 South Michigan Avenue, Chicago, Illinois

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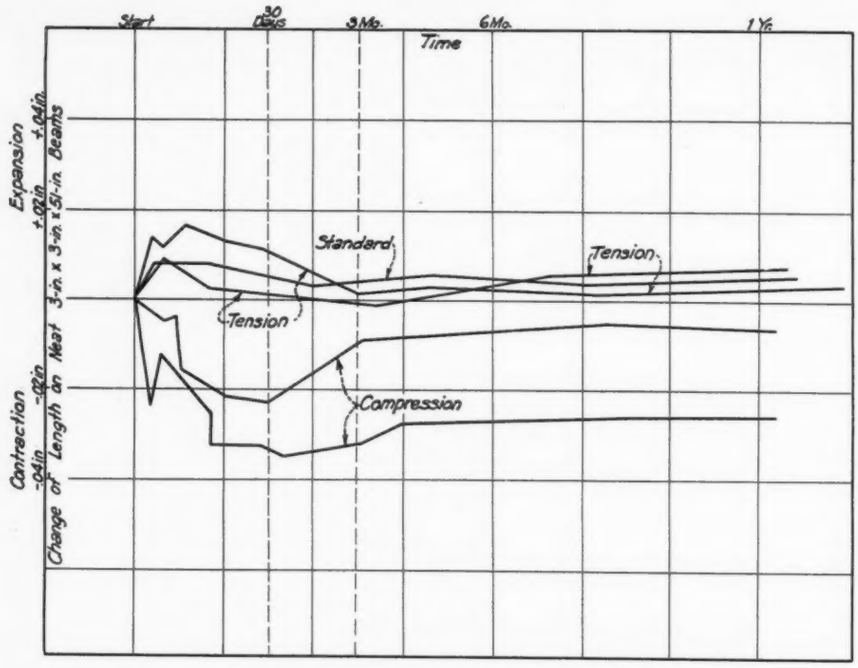


Length change of neat cement beams in wet storage under pressure and tension; 42 percent water mix

Experimental Tests on Neat Cement

By S. L. MEYER

Experiments give insight into what may be expected when different forces other than tension or compression are applied to hardened neat grout

THE tests on neat cement herein described include some more or less experimental tests rarely made. In this instance, the tests were made to give the engineer confronted with neat cement problems, involving other properties than just tensile or compressive strength, at least a little insight into what to expect from hardened neat grout when different forces are applied to it. The chemical composition of the cement used and its fineness are given as a possible help to the engineer to correlate this cement with the kind of cement he may be using.

Time and facilities did not permit tests for comparison at high-temperature and high-pressure storage. Previous tests had shown that high temperature greatly accelerates early strength and decreases later strength, while pressure acts the same way but to a much lesser degree.[1]

Dry strengths usually were lower than wet strengths, as, being placed in an atmosphere of low relative humidity, some water needed for rapid hydration and development of strength was lost by evaporation; also the loss of water from a very wet mix (42 percent mixing water) caused sufficient shrinkage to result in a network of fine surface cracks. Such shrinkage puts the core of the specimen in compression and the surface in tension. When the tension stress at the surface

(Continued on Page 54)

[1]*The Petroleum Engineer*, March, 1936, page 30, also *Rock Products*, December, 1936, page 54-56, "Oil Well Cements."

PHYSICAL PROPERTIES OF NEAT OIL WELL CEMENT

	Storage	Age to time of test					
		1 day	7 days	28 days	3 months	6 months	1 year
Shear wet		202	211	299	333	358	345
Shear dry			135	215	445	386	211
Modulus of rupture	Wet	683	1,014	1,995	1,317	1,164	1,515
Modulus of rupture	Dry		253	310	388	298	347
Modulus of elasticity	Wet	1,176,800	2,800,000	2,791,000	2,737,000	3,150,000	2,520,000
Modulus of elasticity	Dry		1,756,000	1,347,000	1,231,000	1,365,000	1,540,000
Compressive strength	Wet	1,990	6,125	7,700	6,983	7,100	6,800
Compressive strength	Dry		4,930	4,250	4,207	4,837	5,266
Tensile strength	Wet	257	451	510	498	535	425
Tensile strength	Dry		245	370	386	330	333
Bond strength	Wet	154	109	129	180	211	119
Bond strength	Dry		162	240	183	194	166
Plate adhesion	Wet	55	34	51	80	69	*
Plate adhesion	Dry		*	*	*	*	*
Polished plate adhesion	Wet			50	67		110
Thermal coefficient of expansion per deg. F	Wet	.000051	.000055		.000055		.000056
Thermal coefficient of expansion per deg. F	Dry		.000095		.000102		.000108

All specimens were made from a 42 percent water mix and stored in a damp closet for 24 hours. Specimens for wet storage then were removed from molds and put into water at a temperature of 70 deg. fahrenheit. Specimens for dry storage then were stored in air of laboratory where the temperature varied from 60 to 98 deg. fahr. and humidity varied but was of a low average.

Shear and modulus of rupture were made on 3-in. by 3-in. by 20-in. specimens. Modulus of rupture $= \frac{3 \times \text{load} \times \text{length}}{2 \times \text{width} \times \text{depth}^2}$

Modulus of elasticity tests were made on 6-in. by 12-in. cylinders. Only loads up to 50 percent of failure were used.

Compression strength tests were made on 2-in. by 4-in. cylinders.

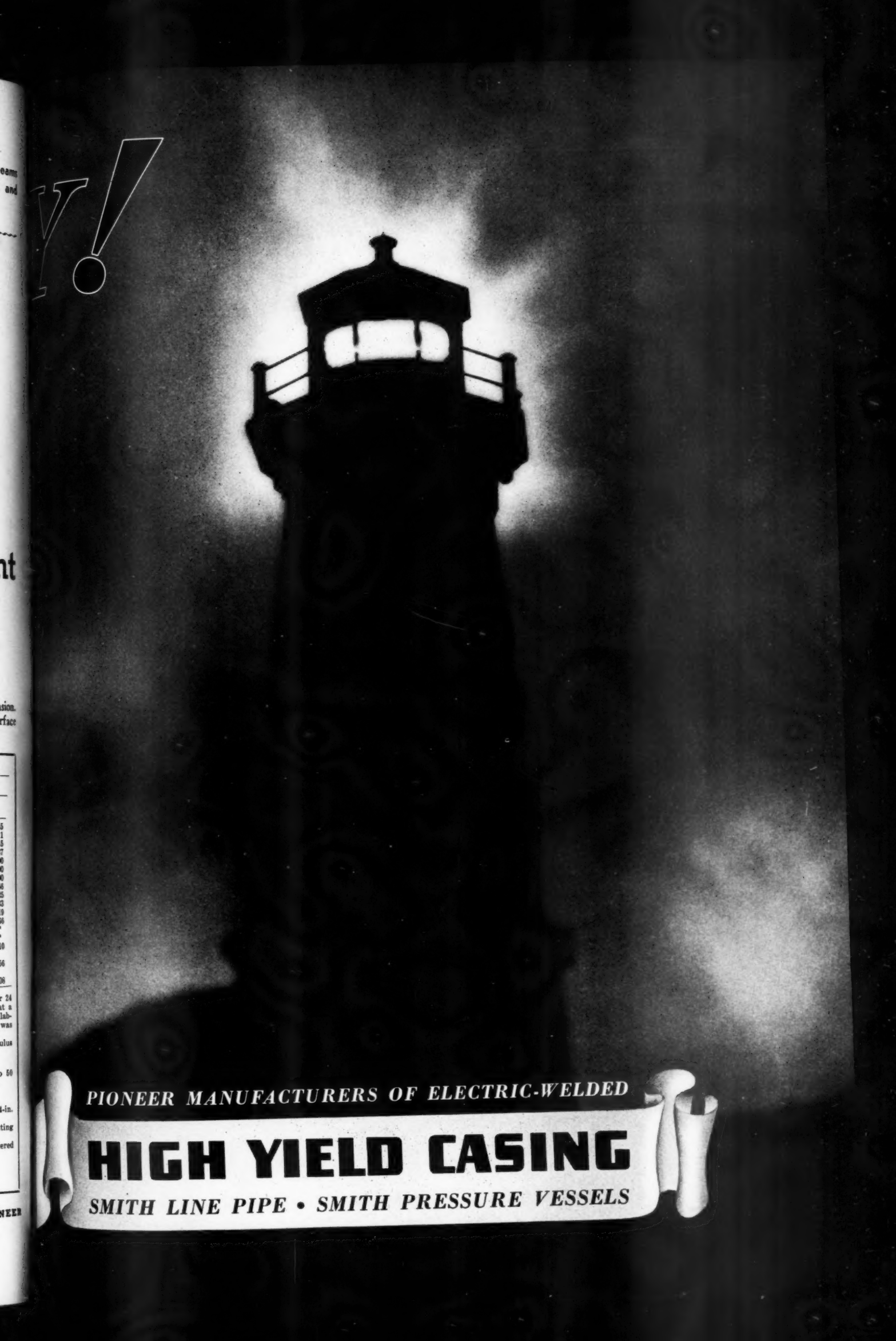
Tensile strength tests were made on briquets, cross-section 1 sq. inch.

Bond strength tests were made on push out tests on rods imbedded in 2-in. by 4-in. cylinders.

Plate adhesion tests were made by casting and storing grout on flat plates and testing in pull perpendicular to surface of plate.

Thermal coefficient of expansion tests were made on bars 1-in. sq. by 13.5-in. long covered with copper foil. Movements due to heat alone are measured.

*Indicates strength was too small to be measured.


PIONEER MANUFACTURERS OF ELECTRIC-WELDED
HIGH YIELD CASING
SMITH LINE PIPE • SMITH PRESSURE VESSELS

PROPERTIES OF THE OIL WELL CEMENT USED FOR MAKING THE PHYSICAL TESTS

Chemical analysis in percent		Calculated compound composition in percent	
Insoluble Residue	.18	$4CaO : Al_2O_3 : Fe_2O_3$	8.51
SiO_2	20.62	$3CaO : Al_2O_3$	9.57
Al_2O_3	5.40	$2CaO : SiO_2$	15.40
Fe_2O_3	2.80	$3CaO : SiO_2$	57.96
CaO	65.10		
MgO	1.89		
SO_3	2.43		
CO_2	.31		
H_2O	1.09		
Total	99.82		
Free Lime	.78		

Fineness
Minus 200 mesh, 97.2 percent
Minus 325 mesh, 91.8 percent
2016 sq. cent. per gram of cement.
Specific gravity, 318
Vicat settings times on a 42 percent water mix.
Initial set 5:00
Final set 7:50

ADDITIONAL ONE YEAR DATA ON HARDENED GROUP

	From wet storage	From dry storage
Loss of free water at 100° C	18.20 percent	3.70 percent
Combined or absorbed water in oven-dried samples	19.32 percent	14.82 percent
Carbon dioxide in dried samples	.73 percent	3.91 percent
Lime hydrate present in dried samples	22.80 percent	13.80 percent
Apparent specific gravity undried	2.06	1.75
Actual specific gravity undried	2.25	2.38
Calculated pore space	8.40 percent	26.40 percent
Heat of hydration and carbonation	94.40 cal./gram	95.40 cal./gram

The heat of hydration and carbonation is higher on dry storage specimens than wet storage ones, because of the great degree of carbonation during dry storage. The heat of carbonation is much greater than of hydration, even though the dry specimens still contain more anhydrous cement still unacted upon.

(Continued from Page 50)

becomes too great it is relieved by cracking, lowering the effective cross-section and, therefore, its resistance.

This difference between dry and wet storage appears to decrease at the later periods. There are three possible explanations of this: the wet specimen although stored in a condition to promote hydration also is in a condition to aid crystallization. The growth of crystals may have a disrupting effect and they also may increase brittleness, which latter condition tends to place a specimen at a disadvantage while undergoing test, due to imperfection in testing methods.

The dry specimens in time absorbed considerable carbon dioxide. If this formed calcium carbonate it would increase the density and possibly decrease some of the shrinkage cracking; but if it attacked the calcium silicate it would lower strength. The adsorbed water, although present only in small quantities at the later periods, probably is still available for cement hydration and there is considerable unhydrated cement for this water to act upon.

In the modulus of elasticity tests the load was applied quickly and it is felt that creep had a negligible effect here. The figures given are for stress over strain.

Bond strength alone is better for dry storage than wet storage at all periods except one. This appears to be because in dry storage bond adhesion is helped by contact friction due to grout shrinkage causing pressure around the metal.

In dry plate adhesion, warping, due to shrinkage, broke the adhesion bond at an early period. In wet storage, crystal growth hurt the contact joint at later periods, but this did not occur with polished-plate adhesions.

The thermal coefficient of expansion of wet-storage specimens remains about constant, but increases with time for dry-storage specimens.[2]

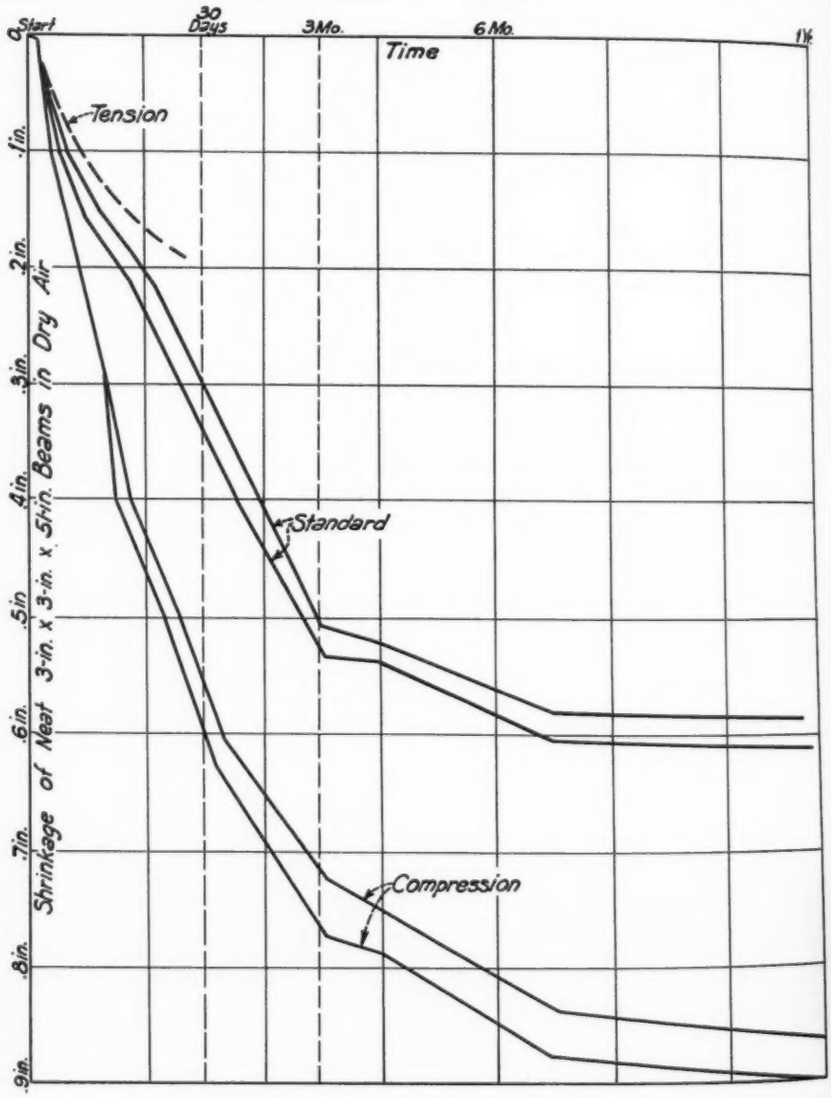
Following are the different kinds of volume changes possible in hydrating cement:

Thermal—Expansion with increase of temperature. Contraction with decrease of temperature.

Humidity—Expansion with gain of moisture. Contraction with loss of moisture.

Autogenous Shrinkage—A decrease

[2] "Volume Changes in Cement, Mortar, and Concrete," S. L. Meyers, *Concrete*, August, 1935, Vol. 43.



Length change of neat cement bars in dry storage under pressure and tension; 42 percent water mix

MAKES HARD JOBS *EASY!*

THIS report covers a typical 'Starcor' job, in a major Oil Company's deep-drilling operation, near Seabreeze. When the crew landed 8200 feet of 9⅝-inch casing in the 12¼-inch hole, they realized that the job had only just begun. For they had gone through gas sands, water sands, loose gravel beds and what not. All of it had to be shut off somehow, and to do it would take 1000 sacks of cement.

Now, that much cement would unbalance the mud column to just about the limit of the mud pumps—with frictional resistance to overcome, they'd never reach bottom! On the other hand, a thin, sloppy cement wouldn't hold the job.

'Starcor' Did the Trick!

'Starcor' was the answer—and the Oil Man's cement certainly made good. There was a partial failure of water supply, so mixing and pumping to position took one hour and 53 minutes! Temperature at bottom of well was over 180°. Under these conditions, ordinary cement would have been unpumpable.

But 'Starcor', mixed to 15.5 lbs. per gallon, flowed so freely that pump pressures went up to only 2200 lbs. Consider the fact that 1000 sacks of 'Starcor' weigh 48 tons, that mud weight was 9.5 lbs., cement weight 15.5 lbs. per gallon—and a simple calculation will convince any Oil Man that there was little if any frictional resistance. Under pressures produced at 8200 ft., temperature 180° F., 'Starcor' was still free-flowing. Talk about pumpability!

'Starcor' pumps readily in a heavy slurry, stays gel-like to resist mud contamination, develops high strengths at early ages, gives a long-life shut-off, even in sulphate waters. 'Starcor'* and 'Incor'*—Oil Men's cements, both—between them meet every cementing requirement. Made and sold by Lone Star Cement Corporation, Dallas . . . Houston.

*Reg. U. S. Pat. Off.

TWO PORTLAND CEMENTS—BOTH MADE FOR OIL WELLS

Properties	'Incor'	'Starcor'
Greater pumpability	Free pumping at 15 to 16 lbs.	
Gel-like body	Reduces mud contamination; doesn't settle out	
Controlled setting time	Normal UNDER 140°	Normal OVER 140°
High early strength	Drill out 1 to 2 days	Drill out 2 to 3 days
Sulphate-water resistance	Good	Exceptional sulphate resistance

of total volume when gel is formed from dry cement plus water.

Chemical Expansion—Increase of volume due to hydration of free lime and free magnesia, or the formation of calcium sulpho-aluminate.

All the foregoing factors, acting together with creep at different rates and in changing directions, serve to produce the nonuniform movement shown on the accompanying graphs. Where the specimens are stored in dry air the magnitude of shrinkage effects is much greater than that of other factors causing volume changes, and the decrease of length with time is more pronounced.

By creep, or plastic flow, in concrete is meant a movement, or deformation, of the concrete attempting to escape a stressed condition. With creep there is no change of volume, only a change of form. In the case of the bars stored under pressure the greater shortening here, as compared to the standard bars, is due to creep or the tendency of the concrete to flow away from the pressure applied at each end, which was 500 to 600 lb. per sq. in.; at the same time the specimen is thickened in cross-section.

Change in length under tension as a result of creep is not very apparent, possibly because the specimens broke very easily if placed under a sustained weight of greater than 60 lb. and this may have been too little to produce a measurable difference in length.

Creep is greater in dry than wet specimens because to deform a wet specimen the water in tiny gel capillaries must be moved and this offers great resistance.

Temperature Regulator for Receiving Bath

By M. E. WOOLDRIDGE

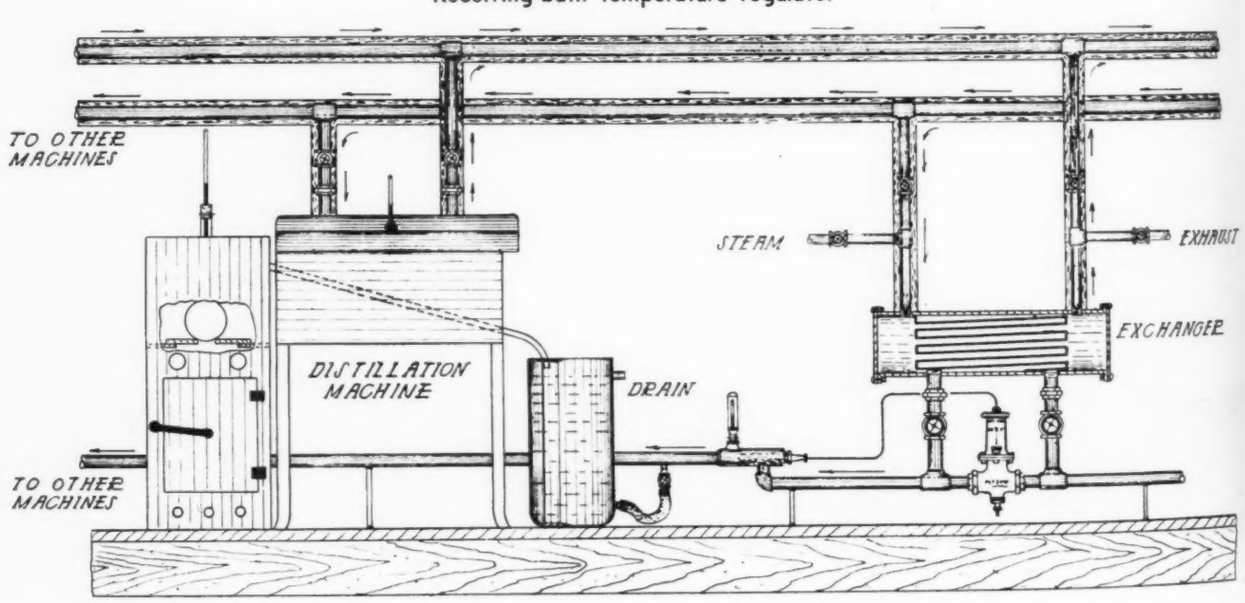
SUCCESS in obtaining correct results in the distillation of light oil products depends largely upon the recovered oil in the graduate being the same temperature as the oil in the flask before the test is started.

This correct temperature is within the specified range, 55 deg. fahr. to 65 deg. fahr., the perfect temperature, of course, being 60 deg. fahrenheit. The accompanying sketch illustrates the distillation machine of conventional type equipped with a circulating refrigerant to maintain the machine bath temperature within the temperature range between 32 deg. fahr. and 40 deg. fahrenheit. This is the regular equipment used by all modern refinery laboratories.

To this equipment is connected an exchanger and in warm weather when the tap water reaches a temperature of more than 60 deg. fahr. the water bypassed through the exchanger by the temperature regulator is cooled by the refrigerant circulating in the opposite direction. There is no danger of water freezing in the exchanger because only a small amount of refrigerant circulation is necessary. In the cold season when the tap water is below 60 deg. fahr. the operation is reversed, steam being circulated through the exchanger instead of the refrigerant. It is understood, of course, that different valve and regulator adjustments are necessary for the two procedures.

This water at a temperature of 60 deg. fahr. is circulated through the glass receiving bath jars by means of a small hose connection. The drain of the jars also is connected by hose to the sewer. The hose connections are used so that the jars can be moved freely, connected or disconnected. The end of the water line is connected to a receiver so that the bath is maintained at 60 deg. fahr. for bringing the samples to the correct temperature before a test is begun.

Receiving-bath temperature regulator



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During five years of service in different fields under a wide range of conditions, no pumping problem has been encountered that cannot be handled efficiently and economically by the Kobe Hydraulic Pump. It has proved itself the *all-purpose** pump and this proof is a matter of record that is available to any oil company executive for examination at any time.

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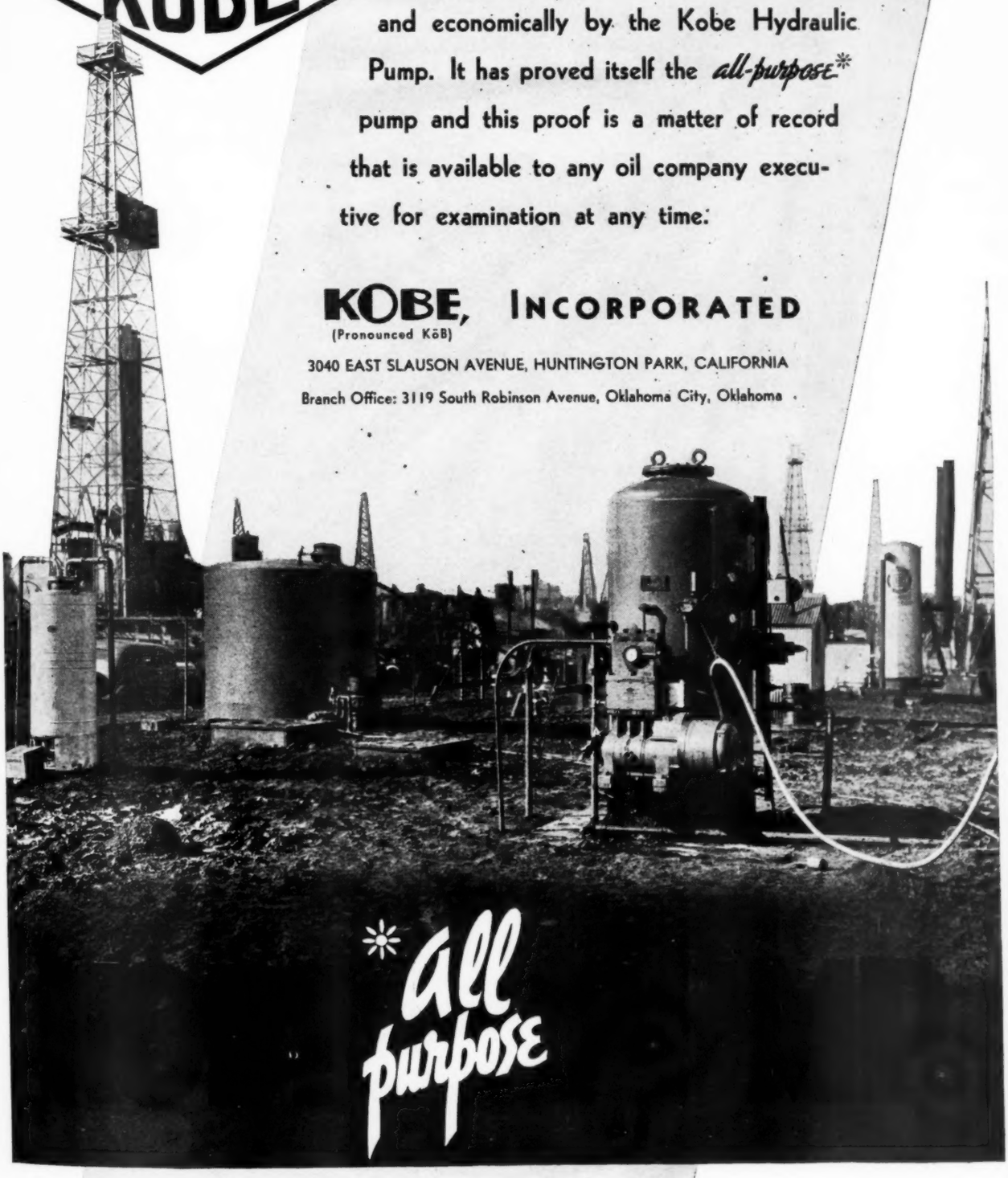
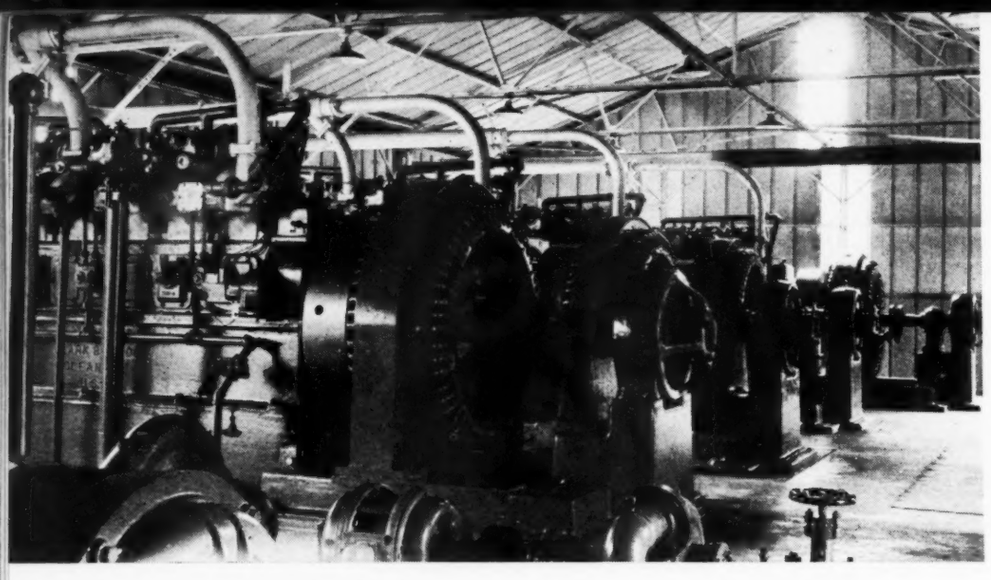




Interior of powerhouse of Olean Petroleum Company at Kanesholm, Pennsylvania, showing generators driven by vertical gas engines

Details of Olean Petroleum Company's plants installed in field for power generation and pumping water in connection with water-flooding operations—efficient practices reflected in low operating costs

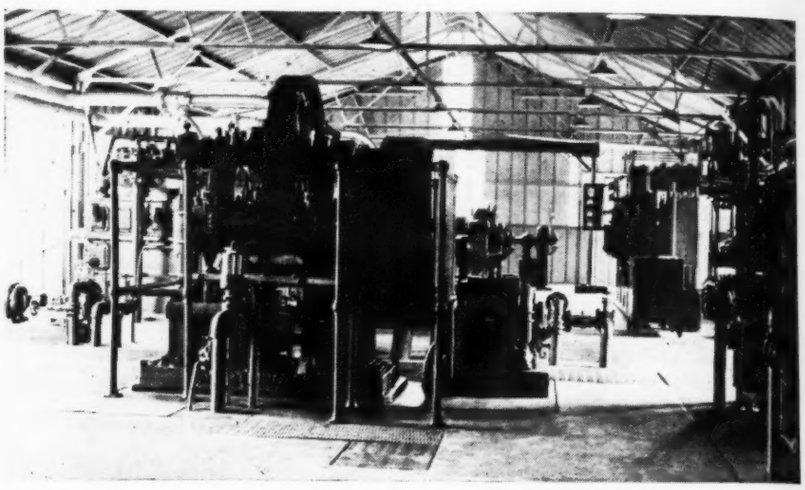
A Successful Water-Flooding Project Near Kanesholm, Pa.

By J. C. ALBRIGHT

ONE of the most successful water-flooding operations in the eastern fields is that of Olean Petroleum Company in Kane County, Pennsylvania, near Kanesholm, a few miles southeast of Bradford, the birthplace of water-flooding as it is known today. Publicity has been studiously avoided by the management of this company, and consequently other water-flooding projects not so extensive in scope have been referred to and quoted more often than this property when discussing this phase of secondary oil recovery from depleted fields in Pennsylvania and southern New York State.

This property now is approximately 5300 acres in extent, and both the water input wells and oil wells are approximately 2100 ft. deep. With but a few exceptions, both classes of wells have been drilled only recently, the old producers intentionally being rejected as serviceable as the flood project progresses across the property and carefully plugged to prevent loss of oil or undesirable migration of flood waters. At the present time only about 210 producing wells have been drilled to recover the residual oil from the sand that is being flooded. In the outlying sections not yet affected by the water drive, many of the original wells are being pumped or produced intermittently by "blowing" with air or gas to recover what oil may be had by this method of primary production.

Because of the large acreage covered by this property, Olean Petroleum Company's problems, particularly those connected with the most economical development of power, have made it necessary to install equipment arranged somewhat differently from that on the smaller leases in the water-flood area of Pennsylvania. When producing oil from the wells at the depth to which they are necessarily drilled, numerous large central powers would be required, if powers were utilized, and the loss in salvage due to moving these powers as the flood progressed, indicated that small individual well-pumping units, powered by electric motors of low hp., would be more satisfactory and extremely economical under the conditions encountered.



Triplex pump, used only as a standby. Portions of water filters and control board can be seen in right distance

At the time Olean Petroleum Company began to acquire acreage in this part of Pennsylvania for water-flooding, plans were formulated to operate the property in the above-mentioned manner. A central powerhouse was designed for the machinery to generate sufficient electric power to produce the water used in flooding and to pump it to the wells. The design of the powerhouse provided for future extensions as required, and for the adequate housing of all the equipment needed, such as gas-engine-driven electrical generating units, flood-water pumps, and auxiliary equipment for general water-flooding operation.

The size of the project at the present time requires four units, three of

Service records of National Sucker Rod performance substantiates the claim that proper rod selection, to fit the particular pumping condition, is an absolute necessity for efficient, economical performance.

To assure National Sucker Rod users peak efficiency and economy, our engineers have made extensive surveys of pumping conditions in various fields. From this accumulated data they are prepared to make the proper rod selection to meet any pumping condition.

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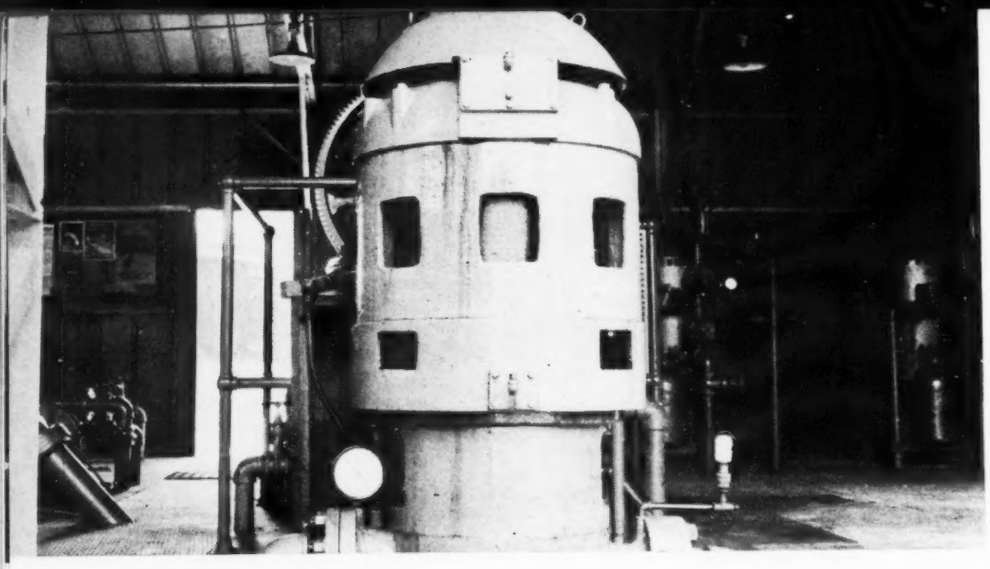
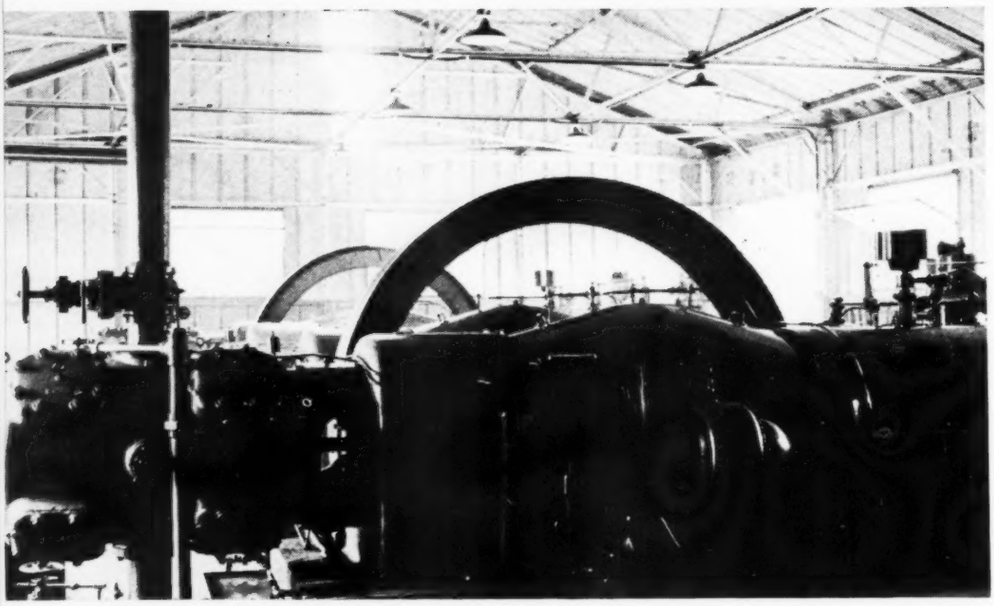


Top section of centrifugal pump used for handling water through transmission system to water input wells



Two gas-engine-driven compressors in powerhouse employed to lift oil from stripper wells in areas not yet waterflooded

which consist of 180-hp. Clark Bros. type Z gas engines and the fourth, recently installed, a 240-hp. gas engine. All are vertical multi-cylinder 4-cycle units; three are 6-cylinder engines and the fourth an 8-cylinder engine. The a-c. generators are direct-connected to the gas engines and turn over at engine speed, which is 514 revolutions per minute. The generators, 480-volt, 225-amp., 60-cycle, 187-kva. G.E. machines, have the exciters mounted upon, and driven by the tailshaft of, the generators.

One feature of these engines is that instead of the bearings that carry the camshaft being babbitted, they are mounted upon a series of SKF roller bearings. Another feature is the type of valve seats, which include removable inserts, replaceable when necessary to prevent the valves from wearing down into the cylinder blocks. Lubrication oil is continuously fed to a centrifuge, which removes impurities accumulated while flowing under pump pressure through the crankcases and oil lead lines and reduce greatly the suspended carbon and also oil sludge.

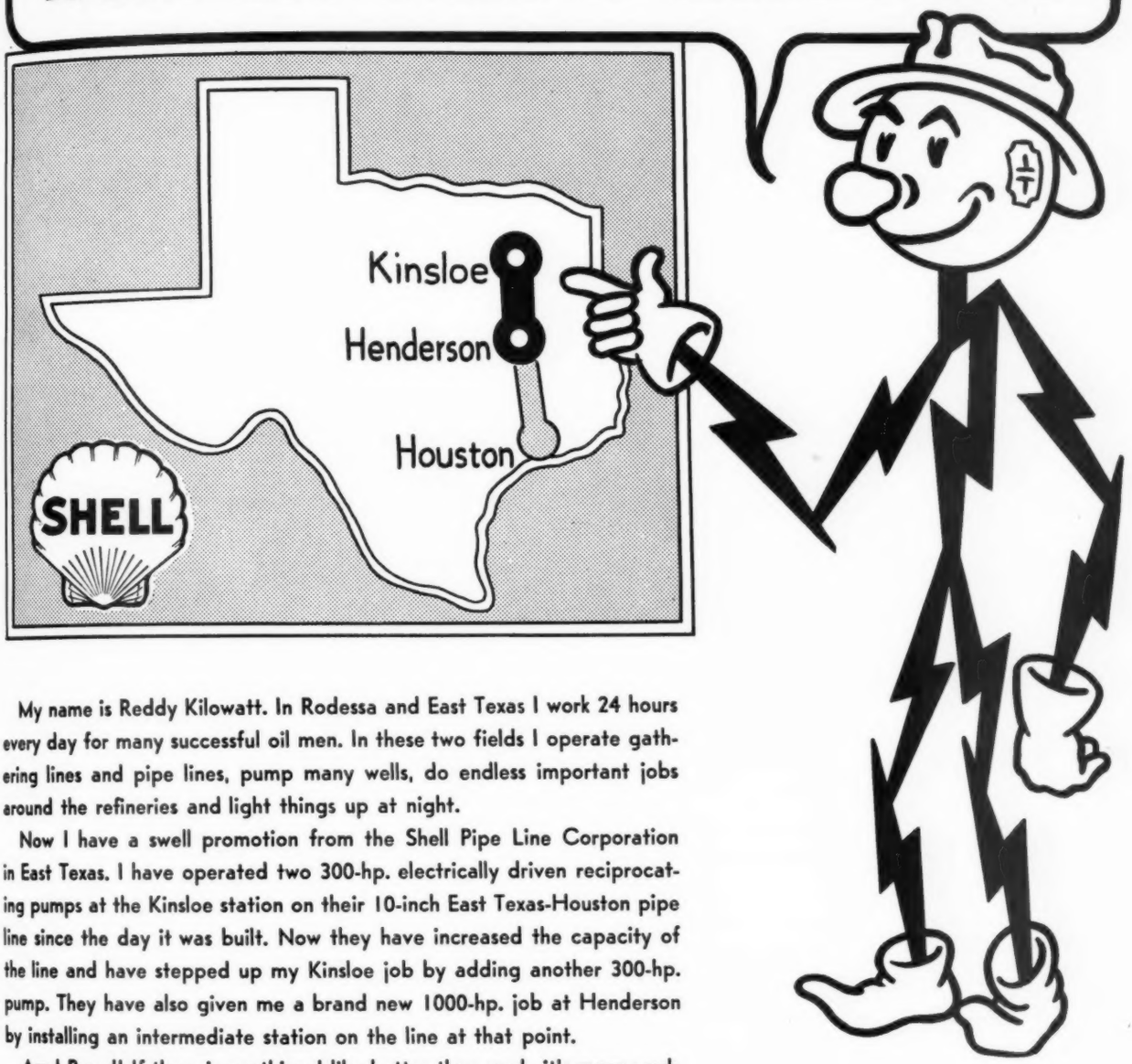
The water system installed to cool these engines is somewhat unusual for a power plant of this type. An indirect cooling process is employed whereby soft water, free from mineral salts and scale-forming properties, is used to

Power building

maintain the desired operating temperatures of the water-jackets without the danger of cracking the heads. All water produced from local wells used for flooding the producing sand is pumped to the central power plant. This raw, untreated water directly from the wells cools by counterflow the recirculating engine jacket cooling water through a Harrison tubular-type cooler. This cooler is one of the most recent developments in heat-exchanger equipment, utilizing high transfer rates with thin tube walls and highly turbulent flow.

The engine jacket water cooler is extremely compact, the overall dimensions being 22½ in. by 20 in. by 16¾ inches. An actual test conducted recently with this cooler illustrates its

I have a swell promotion from the Shell in East Texas



My name is Reddy Kilowatt. In Rodessa and East Texas I work 24 hours every day for many successful oil men. In these two fields I operate gathering lines and pipe lines, pump many wells, do endless important jobs around the refineries and light things up at night.

Now I have a swell promotion from the Shell Pipe Line Corporation in East Texas. I have operated two 300-hp. electrically driven reciprocating pumps at the Kinsloe station on their 10-inch East Texas-Houston pipe line since the day it was built. Now they have increased the capacity of the line and have stepped up my Kinsloe job by adding another 300-hp. pump. They have also given me a brand new 1000-hp. job at Henderson by installing an intermediate station on the line at that point.

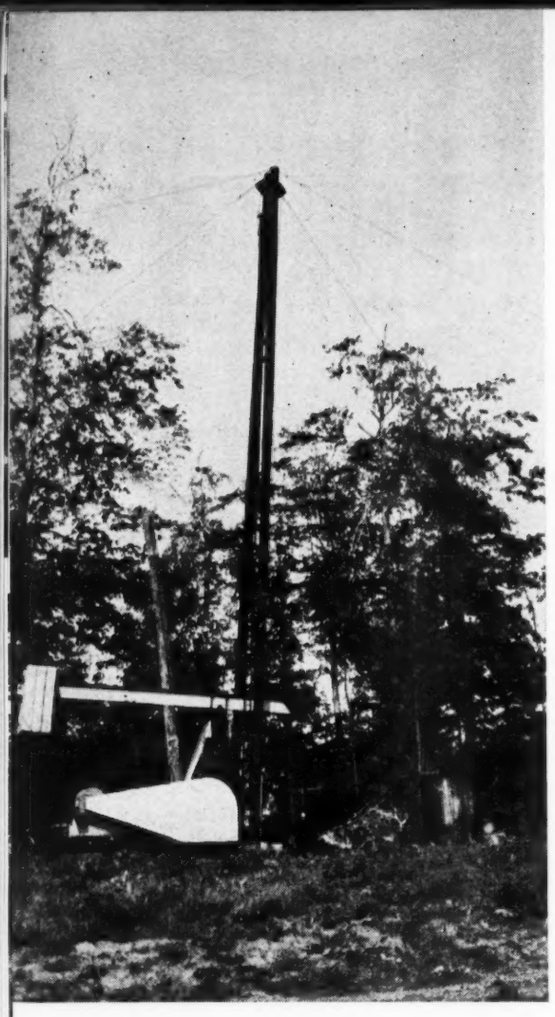
Am I Proud! If there is anything I like better than work, it's more work. I am never sick. I am never lazy. I never get off for any reason.

If you operate in Rodessa or East Texas, I want a job with you. No chore too small; no job too big.

The Southwestern Gas & Electric Company at Shreveport will be glad to tell you exactly what I can do for you on any given job, based on what I am doing for others.

SOUTHWESTERN
GAS & ELECTRIC COMPANY

General Offices: Shreveport, La.



Permanent mast with pump jack over producing well

efficiency, which is shown in the following tabulation:

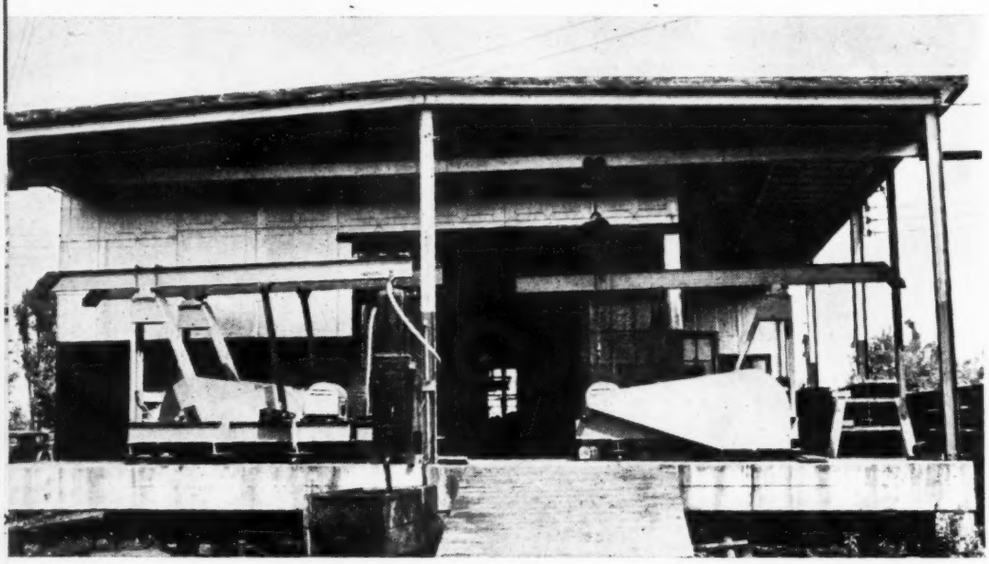
Capacity of cold side, 450 gal. per min. with 10 deg. fahr. rise
Capacity of hot side, 300 gal. per min. with 29 deg. fahr. drop
Pressure drop through cooler, 3½ lb.

Not only is this small cooler large enough to cool the water circulated through the jackets of gas engines of the generating unit, it also is capable of supplying sufficient cool water for maintaining adequate temperatures for the operation of two, 200-hp. Clark horizontal gas-engine-driven compressors, which are utilized in the power room for "blowing" the unflooded stripper wells.

Each generator unit in the powerhouse is provided with a combination generator and exciter panel upon which are mounted the usual switches and instruments for recording and indicating the volume of current generated. Three feeder panels are used, one for the station, another for the field, and the third for a common spare. Each feeder panel is equipped with three-way plug switches so that the power factor on any panel can be determined easily and readily. The power factor at one time dropped as low as .06, but since the installation of capacitators, or static condensers, at the necessary points along the transmission lines, the power factor has been brought up until now it varies between .9 lagging and .9 leading, as the case may be, depending upon the load on the system.

Field transmission lines were laid, using the shortest line between the powerhouse and the point of consumption, the trees and underbrush being cleared to make room for roads and pole lines. The load carried by the electrical transmission lines is maintained at 2200 volts, but current is generated at the station at 440 volts, stepped up for transmission to the wells, and again passed through transformers near a group of wells to reduce it to 440 volts.

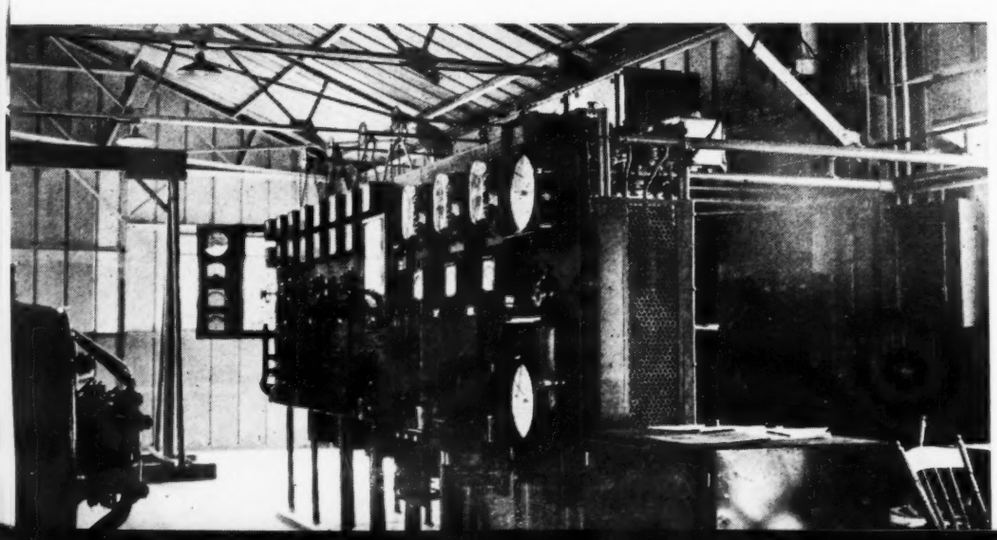
All water produced on the lease, and used for flooding the oil sand, is filtered before it is pumped through the lease transmission and distribution system to the input wells. Filtering is consistently followed on this property so that all turbidity and suspended matter may be removed before the water comes in contact with the sand. Quite a problem has been encountered as a result of the algae found in fresh water in Pennsylvania, and this company has conducted several experiments to eliminate the difficulty. Chlorine has been introduced into the water at the treating tanks to control the growth, but this has not entirely eliminated the evil. Experiments are



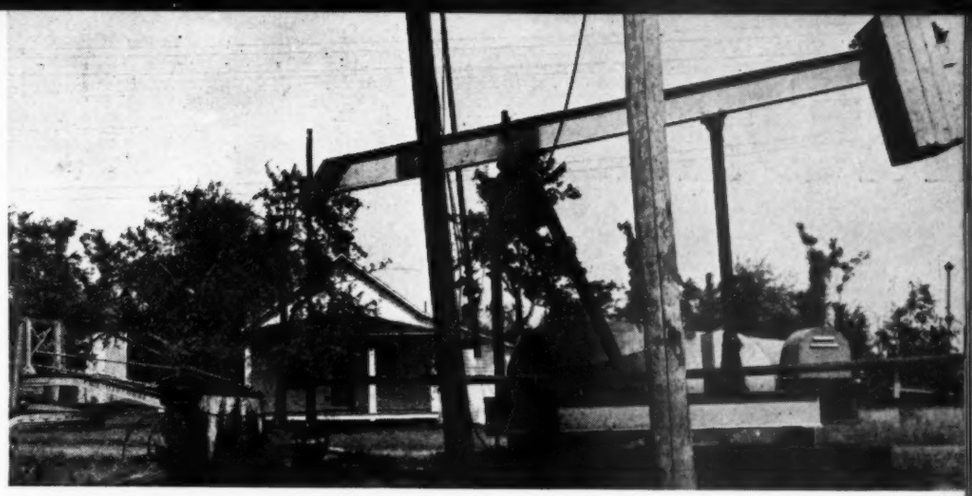
Pump jacks on machine shop dock ready to be taken to field for installation on producing wells of waterflood project

now being conducted by adding ammonia to the chlorinated water. A projected experiment will include a treatment with copper sulphate.

Some of the petroleum engineers who are actively engaged in waterflooding in the Bradford and surrounding fields have found certain types of algae that will thrive in total darkness



Switchboard and controls in powerhouse



Close-up of pump-jack assembly over producing well on water-flood property

and propagate in the sand that receives the flood water. Plugging of the sand and increases in injection pressures encountered are attributed to this condition.

Because of the large volume of water handled on this lease, approximately 6000 bbl. daily at the present time, centrifugal pumps are being operated to force the required volume of flood water to the input wells. The initial installation of the pumping equipment included a 10-stage Byron-Jackson Hydro-Press unit having a capacity of 120 gal. per min. at a discharge pressure of 750-lb. gauge, and driven by a 100-hp. electric motor operating at 3500 revolutions per minute. The next installation was a Wilson-Snyder 6-stage centrifugal pump, rated at 250 gal. per min., also operating against a discharge pressure of 750 lb., and driven by a 200-hp. motor operating at 3500 revolutions per minute. A recent addition to the pumping equipment includes an Ingersoll-Rand 10-stage Cameron centrifugal pump that will handle 250 gal. per min. against a head of 750 lb., driven by a 200-hp. motor with a speed of 3500 revolutions per minute. All pumps installed in the building to handle flood water take water in with a flooded suction, and the motors are equipped with reducing voltage starting switches.

The average electrical energy production of the power plant is 7000 kw-hr. per day. An accurate check has been kept on all operating costs, and the fuel is metered to the engines that drive the a-c. generators. Fuel meter readings show an average fuel consumption of from 14 to 15 cu. ft. of gas per kw-hr., indicating that a consistent overall efficiency is being maintained. Power costs, as outlined below, include gas for fuel, charged to the plant at a rate of 20c per M cu. feet. The charge is a nominal one, set up by the company to determine costs of operation, although the gas consumed on the property has no value due to the lack of an outside market.

Power costs are set up as follows:

Operating costs per kw-hr., including labor, maintenance, repairs, and incidentals	$0.0027
Fixed charges, including interest on investment, depreciation, etc.	$0.0036
Fuel, gas charged at 20c per M cu. ft.	$0.0030
Total cost per kw-hr.	$0.0093

The subsurface source of water supply is some distance from the central power generating plant. Water is produced from the wells with deep-well turbine pumps, the discharge pressure of which is sufficient to force it through the lead lines to the storage tanks at the station. When first installed the pumps were equipped for remote control, and they may be either started or shut down by the operator on duty by pressing the proper button on the control board in the engine room.

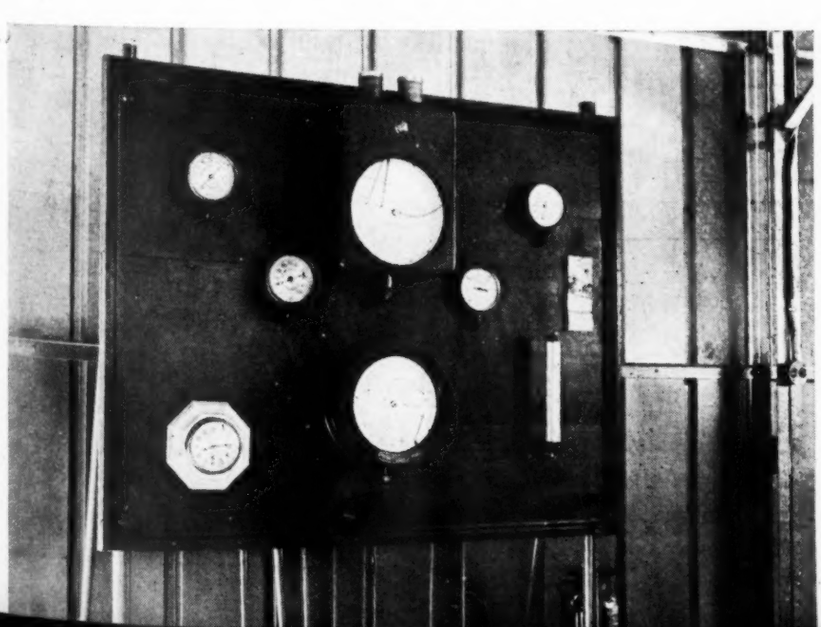
At the present time this property comprises approximately 538 acres under water-flood and has 243 input wells that take an average of 25 bbl. of water per well per day. The following cost for handling flood water is based on pumping approximately 6000 bbl. of input water daily, at an injection pressure of 750-lb. gauge at the pump discharge. The cost of producing the water is shown in the tabulation under the item lifting:

General operating cost, per bbl. of water	$0.0011
Fixed charges per bbl. of water	$0.0009
Power costs per bbl. of water	$0.0054
Lifting cost per bbl. of water	$0.0012
Total cost per bbl. of water injected	$0.0086

In addition to handling the water, producing, circulating, filtering, and transmission to the various sections of the flooded area, the equipment in the powerhouse also produces sufficient electrical power for pumping all water-flood oil wells and operating a comparatively large machine shop. This shop is completely equipped for handling all the necessary repairs to lease equipment, and to produce practically all the auxiliary equipment usually needed for the operation of a property of this magnitude.

All the masts, individual jacks, and other incidental equipment used on the oil-producing wells are manufactured in the machine shop. Each jack is an individual unit equipped with a 3-hp. 440-volt G.E. motor designed to operate at a constant speed of 900 r.p.m. at the voltage supplied to them in the field. Reduction of speed (900 r.p.m. at the motor) between the motor and the jack is obtained by a combination chain and V-belt drive in the reduction mechanism. The pump jacks are serviced in the ma-

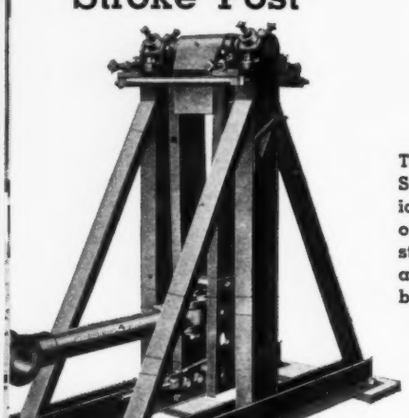
(Continued on Page 66)



Meter board showing recording instruments in powerhouse for gas measurement

NORRIS PUMPING

HEAVY DUTY Stroke Post

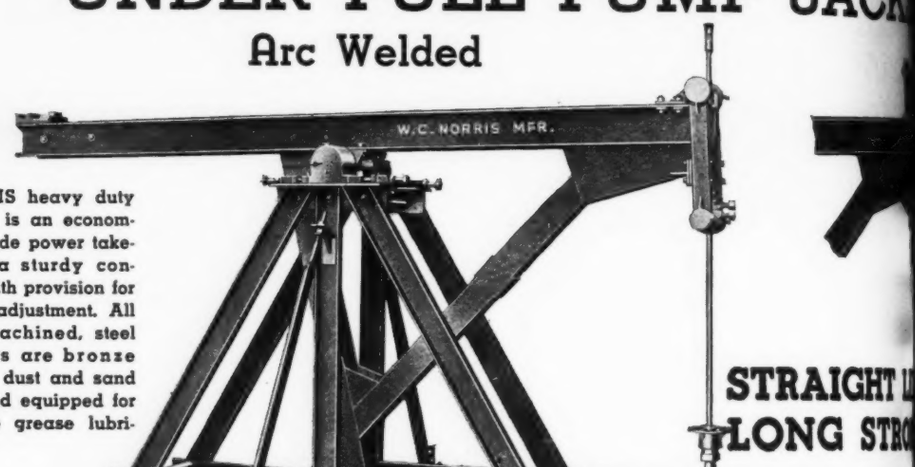


The NORRIS heavy duty Stroke Post is an economical back side power take-off of extra sturdy construction, with provision for adequate adjustment. All bearings machined, steel bearings are bronze bushed, dust and sand proof and equipped for pressure grease lubrication.

From NORRIS Stuffing Boxes, Polish Rods, Sucker & Pull Rods and Working Barrels NORRIS PUMPING EQUIPMENT includes Horizontal, Link Type and Heavy Duty Swings, Stroke Posts and Hold-Downs . . . everything for the efficient and economical transfer of power to the Jack.

UNDER PULL PUMP JACK

Arc Welded



STRAIGHT L
LONG STRO

ARC-WELDED Structural steel frame self contained, with welded beam.
CAPACITIES Type 1218, 6,000 ft.—
2½" Tubing. Type 915, 4,500 ft.—
2½" Tubing. Type 812, 3,800 ft.—
2" Tubing. Type 610, 2,500 ft.—
2" Tubing. Type 509, 2,000 ft.—
2" Tubing.
PRESSURE GREASE BEARINGS
BRONZE BUSHED OR PLAIN MACHINED BEARINGS With oil grooves carry lubricant full length of bearings from large oil reserves.
OIL RETAINERS To hold oil and keep rain and dust out.
LONG STROKES Adjustable by moving the pull-bar bearing up or down on the plate.
STRAIGHT LIFT Is accomplished through an arrangement of link design. Wire Line Horsehead is optional at no additional charge.
ADJUSTMENT Of the jack in relation to the well is positively controlled in moving saddle bearings by adjusting screws and by vertical adjustment of diagonal braces by means of their threaded ends.

W. C. NORRIS Pumping Equipment is designed by oil men to get "the job done" efficiently and economically. Large manufacturing capacity assures the ability to supply NORRIS Equipment in any quantity, large stocks conveniently located at our Branches guarantee immediate delivery.

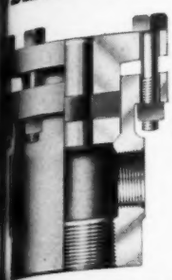
Quality Makes Value

Manufacturer, Inc

ES HOUSTON KILGORE BIG SPRING, TEXAS

EQUIPMENT

W FULL OPENING BING HEAD

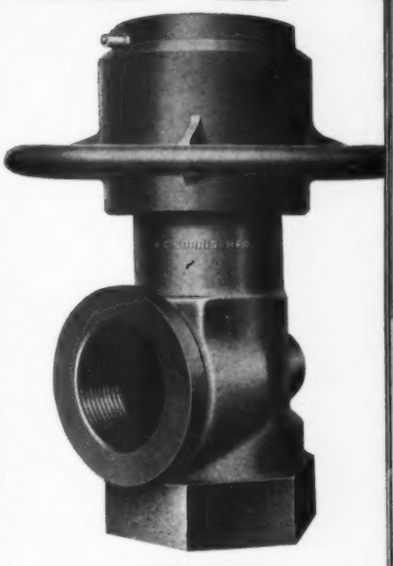


long felt need for a practical, pressive Tubing Head. Tubing ported by collar resting on the and weight of the tubing, together tening of bolts forces the rub- king against tubing wall, thus off any pressure from within. ad either split or solid glands. ead being full opening will pass r tools used in same size casing.

"REGULAR TYPE"

NORRIS FREE WHEELING STUFFING BOX

This new NORRIS Free Wheeling Stuffing Box meets the demand for a low priced, efficient and economical unit of advanced design. Note that the hand wheel allows packing take-up from any position. The oil reservoir in the gland permits lubrication of the polished rod with pressure grease. The felt washer prevents loss of grease and keeps out weather and grit. Furnished in two types, Regular and "Tee Type", both are equipped with babbitt or bronze loose seats, malleable iron bonnets and semi-steel bodies. Tee Type box eliminates use of a Tee fitting under the box to connect on to the lead line and also allows stuffing box to set lower. "Pull-through" type allowing rod pulling jobs by merely unscrewing the bonnet, all internal parts pull out with the polished rod. Lubrication by our pressure grease system prolongs the life of both the polish rod and the packing.



"TEE TYPE"

W.C. NORRIS, MFR.

NORRIS BLUE RIBBON ORKING BARRELS

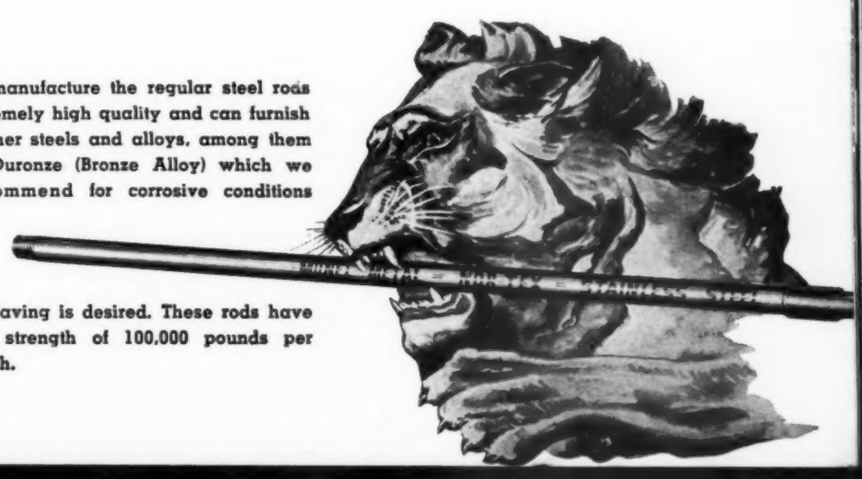
ORRIS Blue Ribbon Seamless Steel Work- Barrels—"The Barrel With The Blue Fin- ." has the highest inside finish of any rrel on the market, being reamed and ned, insuring extremely long valve cup and the tolerances to which they are is well within A.P.I. Standards. Made highest quality seamless cold drawn tubes manufactured to extreme stand- of precision, with careful inspections rding each step in manufacture, they are from all defects. Also furnished in ONZE of the same precision manufacture to A.P.I. Standards, for corrosive con- ons.

NORRIS NOR-TEX

STAINLESS STEEL & MONEL METAL POLISH RODS

You have seen the toothmarks of corrosion on polished rods—dozens of sharp-edged pits that grind out packing as fast as the glands are tightened down. NORRIS Nor-Tex Stainless Steel & Monel Metal Polished Rods are impervious to practically all corrosive conditions found in oil wells and their smooth surface "polishes-in" to a mirror-like finish that practically eliminates packing wear. Recommended for any depth well, due to their high tensile strength. They have been used from four to five years and are still giving excellent service in the same wells that ordinary polish rods lasted less than 6 weeks.

We also manufacture the regular steel rods of an extremely high quality and can furnish rods in other steels and alloys, among them NORRIS Duronze (Bronze Alloy) which we also recommend for corrosive conditions where a saving is desired. These rods have a tensile strength of 100,000 pounds per square inch.



Side view of machine shop

(Continued from Page 63)

chine shop. For example, if one of the units becomes damaged in service, or an adjustment of the belts and chains is required, the man in charge of the lease upon which the unit is used, calls the service department, which immediately dispatches a truck loaded with a replacement jack and motor to replace the one requiring attention. In this manner, trouble is taken care of and the damaged unit reconditioned in the shop by mechanics familiar with their construction, instead of relying upon the mechanical skill of a pumper to make the necessary repairs.

The entire jack assembly is constructed and mounted upon a common steel base, which may be set upon skids at the well, mounted upon a steel substructure, or set on a concrete foundation. Identical construction and a common template for foundation bolts provide for complete interchangeability of these units, and the reduction of speed of from 900 r.p.m. to the average pumping speed of 20 r.p.m. provides adequate power and flexibility to lift the oil from any well in the field. Weights are attached to the jack beam as a counterbalance for the individual well being pumped. These weights are cast from concrete, poured in a common mold that leaves a rectangular hole in the concrete block near one end, making them easy to place when counterbalancing well. Once the weights are slipped over the jack beam and the necessary number placed to counterbalance the well, they are locked in position.

The present production of the water-flooded section of the property, outside of the many stripper wells that are being produced by air- or gas-lift, is approximately 2700 bbl. daily. The ratio of input water to oil produced is approximately 2.22 to 1. The average kw-hr. required to lift a bbl. of oil from an average depth of 2100 ft. by the method employed by Olean Petroleum Company, is .76, making the power cost per bbl. of fluid lifted approximately seven mils.

In the computation of costs for the generation of electrical energy and the handling of water for flooding the following tabulation is shown:

Water production and handling costs, per bbl.	$0.0086
Power generation	$0.0093
Total cost of power and water	$0.0179

When extended to cover the volume of water and amount of power used each day the costs are as follows:

Daily cost of water	$ 51.60
Daily cost of power	65.10
Total daily cost of power and water	$116.70

And when extended to be divided by the number of bbl. of oil produced, shows the following production cost:

$116.70 + 2700 = $0.0432, power and water costs per bbl. of oil produced by water-flooding.

Analyses of Michigan Crude Oils

THE growing importance of Michigan as an oil-producing state has prompted the United States Bureau of Mines, Department of the Interior, to extend its study of the general characteristics of crude oils to include representative samples from 13 fields in eight counties in the lower peninsula. The resulting report indicates that the oils are predominantly paraffin-intermediate-base, wax-bearing crudes, yielding 25 to 35 percent of highly paraffinic gasoline and about the same amount of kerosene and gas-oil combined, 12 to 15 percent of lubricating oil stock, and 20 percent of residuum with a carbon residue of about six to seven percent, according to the Bureau of Mines method of crude-oil analysis and classification. There appears, also, to be some correlation, which has been portrayed graphically, between certain properties of the crude oils and both the geographical location and geological structure of the oil-producing areas within the state. The producing horizons from which the samples were obtained are represented by the Berea sandstone, Upper Traverse, and Traverse limestones, and the Dundee and Trenton limestone formations.

The samples from the Dundee limestone are similar to each other with certain exceptions. These differences appear in production from this formation outside of what usually is termed the Central Michigan area. The properties of certain crude oils produced within the area are much alike but show variations depending upon the distance of the producing pool from the center of the basin. The Traverse limestone samples show local variation but in general are not materially different from the Dundee production. The samples from the Muskegon and West Branch fields show considerable variation from the other limestone production in a number of properties. The Berea sandstone crude oil is characterized by relatively high viscosity of the vacuum fractions.

The 15 samples of Michigan crude oils, for which individual detailed analyses are given, were collected during May and June, 1936, and therefore represent current production, and the analyses are on a comparable basis. The oldest well covered by the samples was completed during November, 1927, and six of the samples were from wells completed in 1936. Analysis of a sample from the Bradford Third Sand of the Bradford field, McKean County, Pennsylvania, is included for comparison.

The report gives a brief discussion of Michigan oil fields, pointing out that the state has an area of 37,000,000 acres, of which approximately 20,000,000 acres have been classified as possible oil-producing areas. Only 5,000,000 have been prospected, but it is possible that a large productive area may yet be found.

Copies of Report of Investigations 3346, Analyses of Crude Oils from Some Fields of Michigan, by E. L. Garton, may be obtained without charge upon request to the Information Division, Bureau of Mines, Washington, D. C.

Exterior view of Rogers Compressor Station

By

FRANK H. LOVE

Compressor Station Has Unusual Record of Performance

Rogers Station of Arkansas-Louisiana Gas Company has been operating almost continuously since 1911 — was second compressor station constructed in Louisiana

PERHAPS no more picturesque compressor station, nor one having a more interesting history or better record of performance, is in operation in the Mid-Continent today than the Rogers Station of the Arkansas-Louisiana Gas Company. Constructed in 1911, 28 miles north of Shreveport at Lewis, Louisiana, this station has been in almost continuous operation since. It would be difficult to estimate how many millions of cu. ft. of gas has passed through it during that period. The daily capacity is 50,000,000 cu. feet.

This was the first compressor station built by the Arkansas-Louisiana Gas Company, and the second to be constructed in Louisiana. Two years previously the Dawes interests of Chicago erected the Mills Station at Rodessa. Later, in 1928, that station was acquired by the Arkansas-Louisiana and since has been a part of its system.

Situated on the company's 16-in. trunk line, gas is taken from the Rodessa and Monroe fields and sent to Texarkana, Little Rock, Hot Springs, Pine Bluff, Arkansas, and intermediate towns, as well as to Pittsburg and Mt. Pleasant, Texas, and the East Texas and Talco fields. At present the bulk of the gas is going to Talco for use in drilling and production operations.

Compressor units are the ones originally installed 26 years ago, consisting of three 1300-hp. horizontal twin-tandem, double-acting gas engines. The engines develop a speed of 90 revolutions per minute. Two are equipped with 16-in. liners and one with a 13⅞-in. liner. Originally all had 16-in. compressors, but in December, 1936, one was changed to a 13⅞-in. in order to increase compression on the gas going to Talco. It is noteworthy that the power cylinders never have been rebored, and one of the engines has two of its original cylinders. Two of the compressor cylinders have been rebored once each.

The station has no intake header. After first passing through two scrubbers 54 in. in diameter by 20 ft. long where all foreign matter is removed, the gas is received by the low-stage compressor from the main 12-in. line through 10-in. suction lines at a pressure of 60 lb. and a temperature of 80 deg. fahrenheit. It leaves this compressor at a pressure of 230 lb. and a temperature of 240 deg. and is discharged through a 10-in. line to the aftercooler. This latter is a 3-coil system composed of 2-in. tubes, and serves to reduce the temperature of the gas to approximately 100 deg. fahrenheit. Only that part of the gas going to the Talco field is subjected to 2-stage com-

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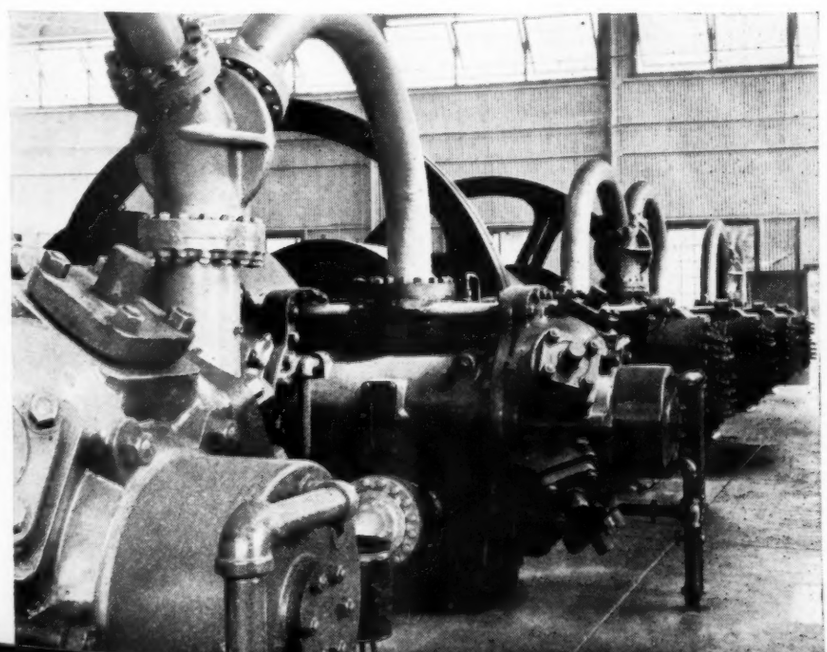
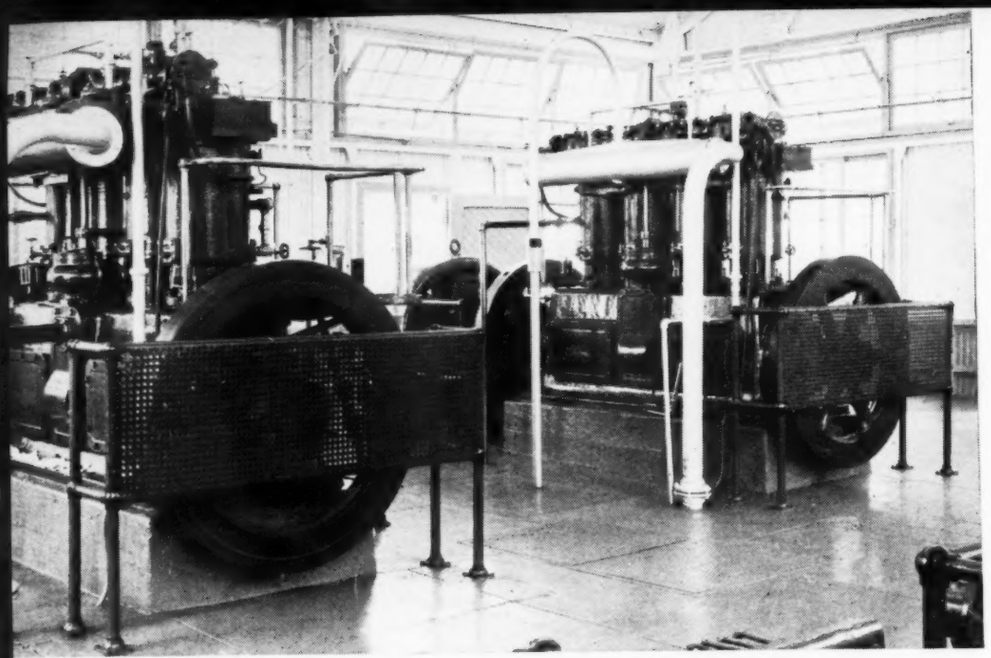
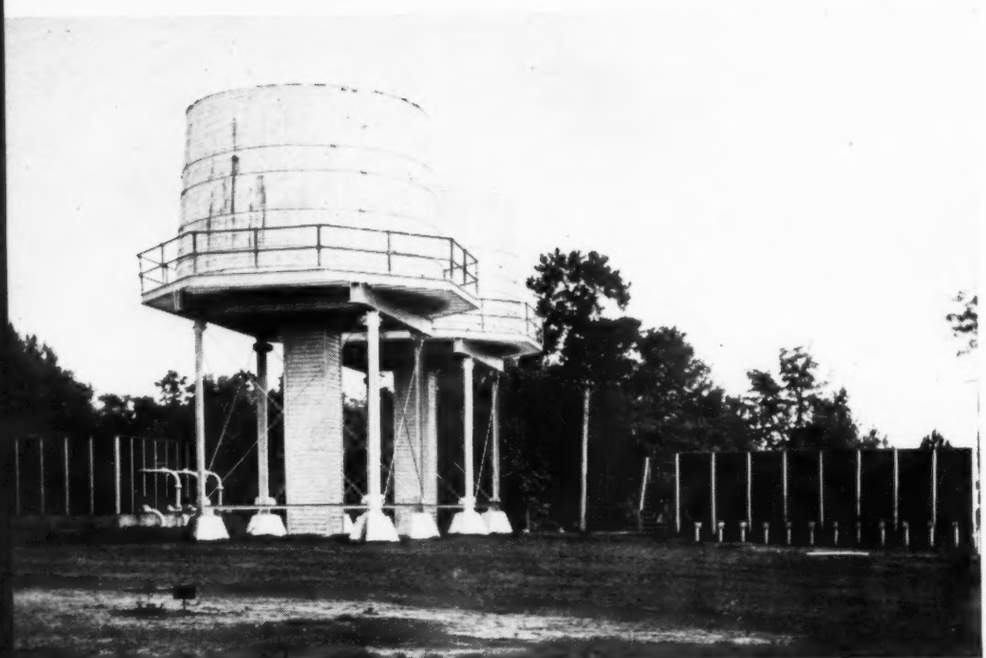


The station has three 1300-hp. horizontal twin-tandem, double-acting units. This view shows the compression ends



Two vertical 100-hp. 4-cylinder gas engines direct-connected to two 65-kw. d-c. generators provide electric power



Two overhead wooden tanks for water. On either side of the tanks can be seen the gas aftercoolers

pression. The remainder is discharged into the main line at a pressure of 315 lb. for delivery to Texarkana, Little Rock, Hot Springs, etc. The 13 7/8-in. compressor boosts the pressure to a maximum of 465 lb., the gas being discharged at a temperature of 280 deg. fahr. and is lead by a combination 10-in. and 6-in. line through a 2-coil aftercooler composed of 3/4-in. brass tubes where the temperature is reduced to approximately 90 deg. fahrenheit. The discharge is through an 8-in. line to Talco.

The main compressor units are equipped with a gravity-feed oiling system to the main bearings, crank and wrist pins, slides, rods, and valves. The oil gravitates to the units from an 800-gal. tank situated overhead in the main compressor room. From there it gravitates to the settling tanks in the basement, being picked up by pumps operated off the prime movers and boosted to a filter. This filter is of the conventional type and is situated on the main floor of the compressor room. The pumps again pick up the oil from here and send it to the overhead tank. The flow of oil can be adjusted, and the entire operation is virtually automatic. Forced-feed lubrication is employed in the cylinders and is separate from the gravity system described.

Water for cooling the engine jackets is obtained from Jeems Bayou, immediately adjoining the station site. This bayou connects with Lake Caddo and thus an ample supply of water always has been available. The process involves the boosting of the water from the bayou to two overhead wooden tanks of 500-bbl. capacity each by means of two centrifugal pumps driven by vertical 40-hp. motors and having a 5-in. discharge and a rated capacity of 800 gal. per min. each. From these tanks the water gravitates to the engine jackets and is returned to the bayou, also by gravity. No cooling tower is required. Water to the gas aftercoolers also is by gravity from these overhead tanks, through a spray system. The water pump is situated at the edge of the bayou, being housed in a small building, and is so arranged that a 4-ft. head of water is maintained on pump intake at all times.

In a 38-ft. by 48-ft. building situated near the main compressor building is housed the auxiliary equipment. Two vertical 100-hp. 4-cylinder gas engines having a 10-in. stroke and 10 1/8-in. bore are direct-connected to two 65-kw. d-c. generators that provide electric power. This power is utilized for pumping water to the engine jackets and aftercoolers, lights for the station and dwellings, and operating the starting-air compressors. There are two of the latter, 8 by 8 units. They take in free air the pressure of which is raised to 110 lb. by single-stage compression. The air is then sent to a 5-ft. by 30-ft. tank situated behind the auxiliary building to await its use as starting air for the engines. In the auxiliary building also is a 25-hp. vertical boiler to provide steam for plant heating.

Gas measurement is made through orifice meters. On the line to East Texas, which includes the new Talco field, the gas is metered at Trees City. Two meters are situated at Vivian, a distance of five miles from the station, for measuring the gas going to Little Rock, Texarkana, Pine Bluff, Hot Springs, etc. A suction meter is at Pine Island for measuring gas from the Rodessa field, and there is one at Mooringsport for measuring gas from the Monroe field.

Fire-fighting facilities always are of the utmost importance at a station handling such a highly-inflammable product, and though the Rogers Station never has had a serious conflagration, the best in equipment has been provided against eventualities. Water hydrants are placed at convenient points around the station buildings and cottages. For the fire system there is a combination 6-in. and 4-in. water line. Water is obtained from Jeems Bayou and power is provided by a 6 by 4 by 6

(Continued on page 72)

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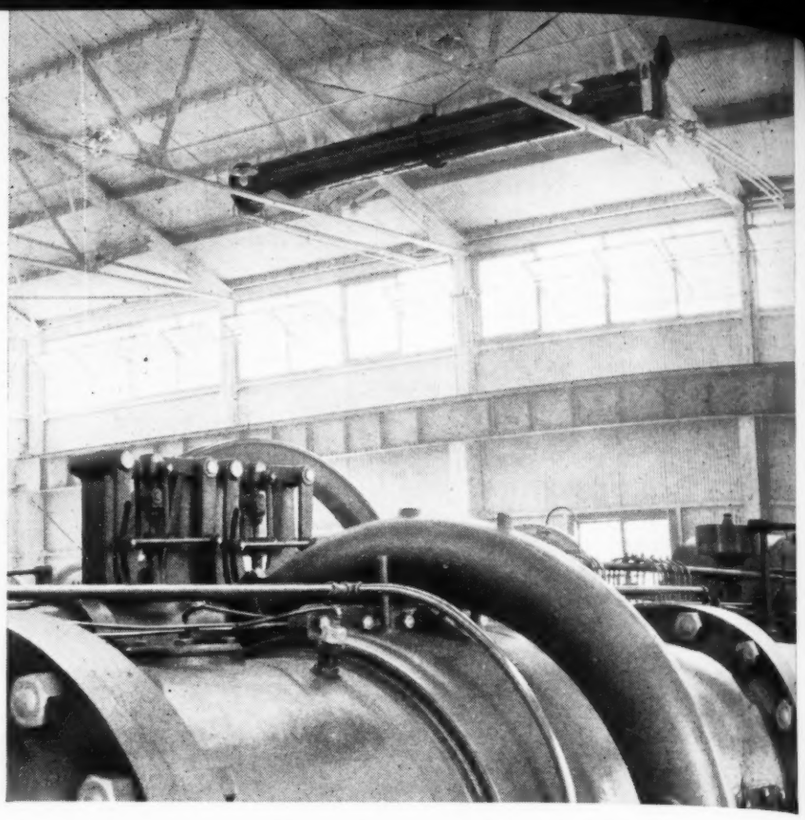
Drilling and development operations; Production and production practices; Refining; Natural gasoline manufacture; Tanker transportation

THE *Petroleum* Engineer



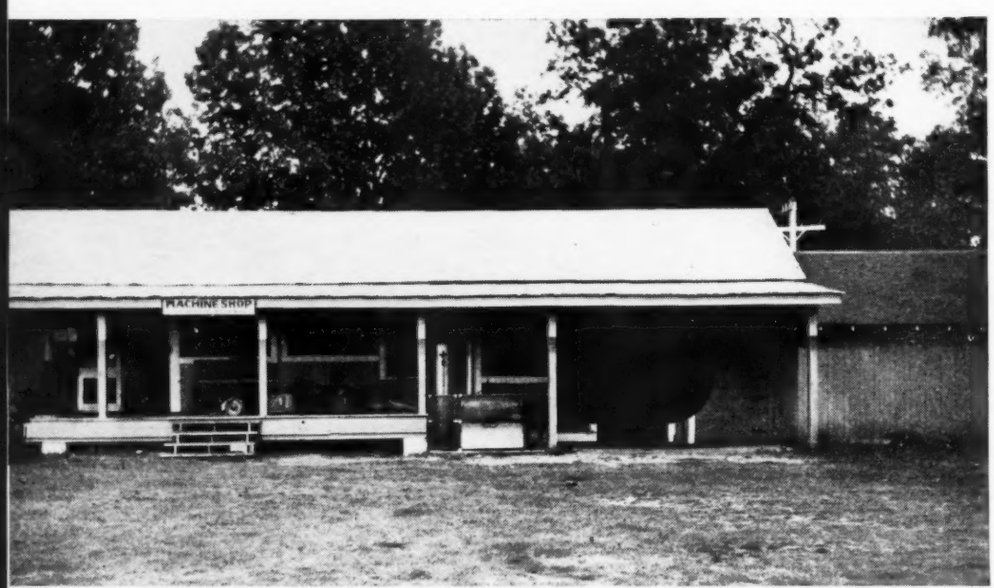
The overhead tank from which lubricating oil gravitates to the engines

(Continued from page 68)

force pump that can develop 120-lb. pressure.

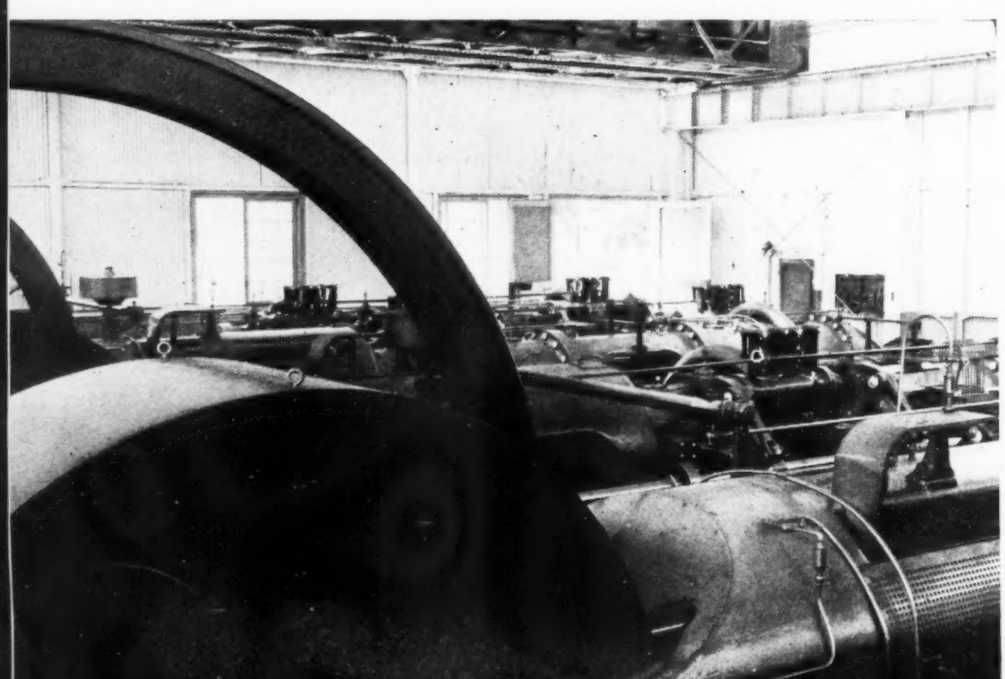
The company camp immediately adjoins the compressor station site. Nine dwellings are provided for employees and their families, and a spacious club house, operated by the Doherty Men's Fraternity, affords recreational facilities.

The enviable performance record made by Rogers Station is a result in large measure of the regular maintenance program observed. Each summer, when the gas load is lightest, all units are completely overhauled. The big items of repair are made during this regular summer schedule. Throughout the year, however, the equipment is carefully watched and at the first sign of anything going wrong the defective part is repaired. This procedure has resulted in the machinery constantly being kept in the best of condition. The machine shop has played no small role in the record made by the station. Housed in a separate building, as shown in an accompanying illustration, it has a lathe, drill press, an Underwood boring bar, power hack saw, hydraulic press, and other items that go to make up a well-equipped shop.



Rogers Station has a well-equipped machine shop

Another factor considered by officials of the company to have a direct bearing upon the successful manner in which the station has been operated is the long term of years the key men at the station have been identified with its operation. It will be of interest to list the names of a number of these men and the length of their connection with the station. S. C. McMillan, plant superintendent, has been at Rogers since August 5, 1918; B. O. Finley, assistant plant superintendent, since 1925; J. B. Powell, operating engineer, since November 1, 1917; T. J. McMillan, operating engineer, since November 1, 1917; S. A. Griffin, oiler, since 1918; H. L. Waugh, oiler, since August 1, 1923; R. H. Pankey, oiler, since June 1, 1925; and R. E. McMillan, oiler, since August 21, 1929. These men through long association are intimately familiar with the station's every working phase and thus are in position to obtain the utmost from the machinery.



An interior view showing a part of the station's compressor units

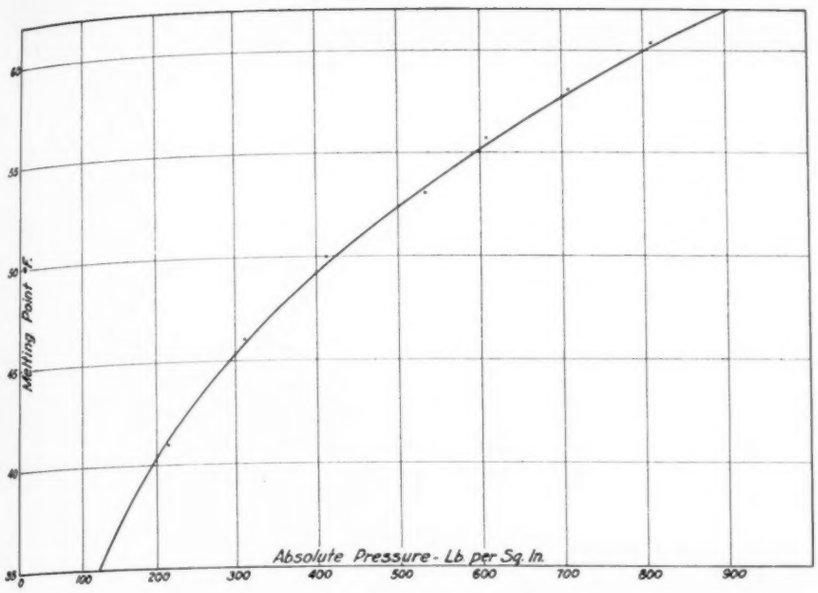


Fig. 1. Melting point of natural-gas hydrates

By
JAS. R. COWLES

●

Part 1

●

The Dehydration of Natural Gas

MOST natural gas contains water vapor originating in the well or at gasoline plants. This vapor is inactive, acting only as a diluent, except when conditions exist that cause its condensation in the transmission system. In doing this it may form either liquid water, or hydrates resembling ice, depending upon the existing conditions. The formation of ice is not likely as hydrates form more readily, and the important factors, such as turbulence, favor them. Drips are inadequate for several reasons: they cannot be placed exactly where needed, they offer no protection against hydrates, they are not effective in eliminating the corrosion caused by the presence of water, and they are wasteful in requiring that some gas be blown from the line.

Dehydration has been adopted to correct these conditions, chiefly the formation of hydrates, which cause either partial or total clogging known as freeze-ups. A dry gas is considered to be one that contains so little water vapor that no liquid water is formed in the system. Then the amount of water vapor allowable depends on the line temperature and pressure. As neither water nor natural gas follow the gas law exactly the deviations must be taken into account.

Numerous methods of dehydration exist, but absorption with liquids is the only one that has found general applicability. Calcium chloride brine, generally refrigerated, is the most outstanding of these agents; however, diethylene glycol is being used, and probably will be more generally adopted in the future. Calcium chloride solutions have several properties not desired that must be considered.

In addition to dehydration, the addition of about 42 parts per million of ammonia gas has been found to eliminate hydrates. This affords a good means of preventing freeze-ups where a dehydration plant is not practical.

This article is the first of a series intended to present a complete survey of the problem of dehydrating natural gas to be transported by pipe line. Though primarily intended to cover the factors influencing service interruptions (i. e. freeze-ups) it was found that dehydration is being practiced on the west coast chiefly to combat corrosion, hence that and other aspects of the problem deserved attention also. It also has been found possible to prevent freeze-ups by the introduction of small quantities of ammonia gas, though this cannot be considered dehydration. As this is in accord with the purpose of this article a section is devoted to the information available.

This discussion is not concerned with freeze-ups at regulators and well heads. These cases constitute a special class and are generally dealt with by means of bottom-hole chokes and heaters.

The writer has attempted to make this article non-technical enough for anyone familiar with natural gas nomenclature to comprehend; however, in order to make available some data not generally found in discussions of dehydration, several graphs of a somewhat technical nature have been included.

Very little of the information used has been taken from data for the dehydration of manufactured gas, as at the present time enough natural-gas plants have been constructed that the differences, chiefly in pressure, have shown the two to be separate problems, and for the present purpose independent.

Definition of Dehydration

In connection with natural gas, dehydration means removing sufficient water vapor (and any entrained liquid water) from the gas so that none of the remaining vapor will condense to water in any part of the pipe-line system. If this is done, hydrates, the cause of freeze-ups, cannot form.[a] When such excess water has been removed the gas may be termed dry, the remaining water vapor having no effect except as a diluent.

Sources of Water in Gas

The water vapor found in gas comes from one of two places. In the gas-bearing sand there is generally contact between the gas and water below it so that the gas in the sand is saturated with water vapor at the existing pressure and temperature. The second source is the absorption oil in gasoline plants. The gasoline is distilled from the oil by admitting "open" steam to the column. This saturates the oil with water, its capacity being sufficient in turn to saturate the gas going through the plant.[b]

a) There may be some doubt concerning the necessity of the presence of liquid water, though experience indicates this to be true. In discussing a recent paper, Hammerschmidt states that he believes liquid water is necessary for the formation of hydrates if none are present.[1]

b) The author has heard of the problem being attacked from this angle, but no data are available.

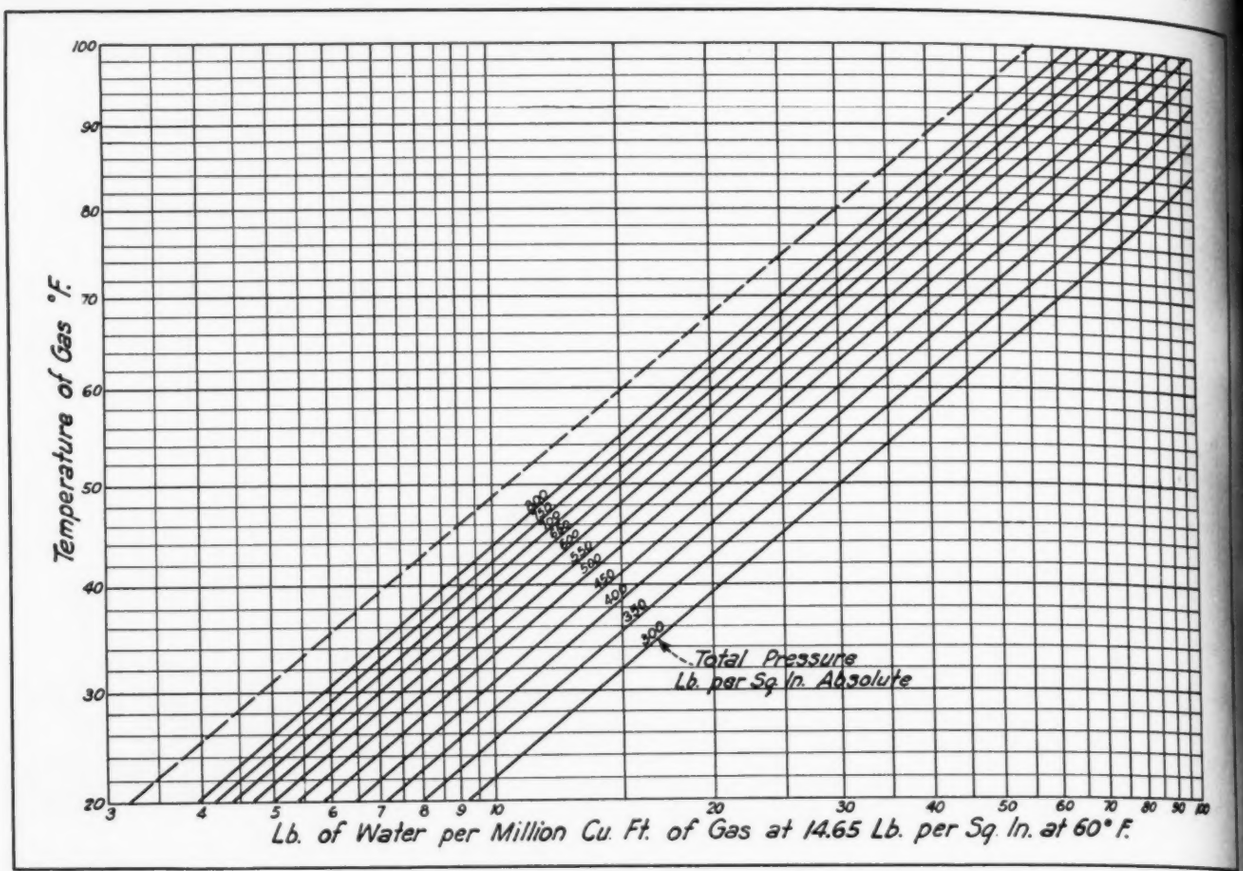


Fig. 2

Gas Hydrates[1, 2]

Hydrates consist of the gas molecule combined with six or seven molecules of water. It is reported that the methane hydrate contains six and those of ethane, propane, and iso-butane seven.[3]

These inflammable compounds resemble ice in several ways, hence their recognition as the actual cause of freeze-ups is recent. The most common form resembles snow, and occurs chiefly in regions of turbulence. Under quiescent conditions a clear solid is formed. Chemically the hydrates have analogues that are well known.

The important hydrate-forming gases are methane, ethane, propane, and isobutane.[c] In these compounds the gas is actually combined with several molecules of water (believed to be six). A typical example is the methane hydrate whose formula is thought to be $CH_4.6H_2O$ (the dot before the H_2O indicating a loose combination, and the 6 representing the number of water molecules combining with one molecule of methane). These hydrates are unstable, and under favorable conditions of pressure and temperature decompose to give the original gas and water. The important characteristics of mixtures of the above possibilities that actually occur, have not yet been determined with great accuracy. Table I gives an analysis of a sample scraped from a pipe. Fig. 1 is a plot of the variation, with pressure, of the temperature at which actual hydrates form, and decompose or melt. The curve is algebraically equivalent to the equation

$$T = 8.9X^{0.285}$$

where T is the forming temperature in deg. fahr., and X is the absolute pressure in lb. per sq. in.

From this consideration it is easy to see why freeze-ups generally are considered to be due to hydrates. Over the usual range of pressures the freezing point of water remains very nearly constant at 32 deg. fahr., while at a pressure of 400 lb. per sq. in. the melting point (hence forming temperature) of the hydrate mixture is about 49 deg. fahrenheit. Actually freeze-ups occur at temperatures com-

TABLE I[1]

Analysis of a Gas Hydrate Sample (Exclusive of Water)

	Gas in Line	*Gas Hydrate Vapor*
Carbon dioxide	0.20	0.44
Nitrogen residue	7.19	6.46
Methane	82.50	56.95
Ethane	5.99	5.66
Propane	3.26	24.97
Isobutane	0.30	4.69
N-butane	0.49	0.83
Pentanes, plus	0.07	0.00
	100.00%	100.00%

[1]Natural Gas Department Proceeding, 1936, p. 169—by E. G. Hammerschmidt, American Gas Association.
[2]Industrial and Engineering Chemistry, 26, 851—by E. G. Hammerschmidt, August, 1934.
[3]"Hydrocarbon Hydrates," by R. W. Miller—American Gas Association Proceedings, 1936, pp. 703-7.
c) Hydrogen sulphide and carbon dioxide also form hydrates.

with

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UNIFORM weight on the bit is maintained all the time by the Brantly Rotary Feed Control. This assures straighter holes . . . more hole per bit . . . fewer round trips . . . less overall drilling time. Dozens of operators are cutting their cost per foot of hole with this modern feed control. Ask the driller who uses one what he thinks of it.

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GREATLY REDUCED *bit wear is saving many dollars for the owner of this "OILWELL"-Brantly Rotary Feed Control*

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parable to this much more often than at 32 deg. fahrenheit.

Perhaps the worst feature of these hydrates is that their formation is cumulative. In addition to turbulence, vibration, and sudden fluctuations in pressure[d] their formation is aided by the presence of existing hydrates. Once formation has begun the rate of formation increases, due apparently to a sort of catalytic action. The hydrates also have the peculiarity of being able to take more water vapor from the gas than is required for the formation of liquid water under the same conditions. Further, the volume occupied by the hydrates is greater than that of the water so contained.

The above properties of hydrates suggest several ways of alleviating the troubles incurred; however, dehydration (eliminating the required liquid water), and less generally inhibition (to be discussed later) appear to be the only sound methods of attack.

Condensation of Water from the Vapor State

Saturated gas is gas containing all the water vapor possible under the existing pressure and temperature. Dry gas already has been defined. From the definition given follows the most practical way of measuring the water present as vapor in a gas, the dew-point method. The dew-point of a gas is defined as the temperature that a polished surface placed in the gas must have for a fog just to form (due to the condensation of droplets of water). In other words it is the temperature at which the gas is saturated under the pressure at which the measurement is being made. In the case of air in a room this means the temperature to which the water in a metal pitcher must be cooled in order to make the pitcher "sweat". This illustration is analogous to the method used in measuring the dew-point of high-pressure natural gas[5]. There are several advantages of using dew-point: it has a direct significance (in contrast to relative or absolute humidity), it is a fairly simple measurement, and it is sufficiently accurate.

Reiterating: a saturated gas has a dew-point of the temperature at which it is. Theoretically, this water-vapor content is dependent only on actual volume and temperature; however, when the basis is the usual M. cu. ft. several corrections must be applied. These have been taken care of in the preparation of Fig. 2.[5] The several solid lines are for different pipe-line pressures and can be used to interpolate for pressures not plotted. The dotted-line is the "theoretical" value (the same for all line pressures) for a mixture of perfect gases. It has little value as the error it introduces is not conservative.

Ground Temperatures

In lines of any length the gas soon reaches the temperature of the surrounding earth, known as the ground temperature. For this reason the dew-point of dehydrated gas is adjusted to fall from three to five deg. fahr. below the lowest ground temperature anticipated. The exact margin depends on the rapidity of fluctuations, and often the capacity of the plant being used.

No definite data can be given on ground temperature due to variations in locality, and also the construction of the pipe line under consideration (river crossings etc.). The only criterion is found in ground temperatures actually measured at the most severe points. In general, there is a lag between atmospheric and ground temperatures. Pickup[6] gives an interesting graph of an actual case where records were kept over a period of time. Further references will be listed in a bibliography at the end of the last article in this series.

The Effect of Water Vapor on Gasoline Content

Generally the effect of water vapor on gasoline content is of no great concern, but it is of concern occasionally. Burnham shows, by means of an exaggerated example, that the removal of gasoline vapors from a gas tends to cause a condensation of some of the water vapor.[7] By the same reasoning a removal of water vapor tends to cause a condensation of some of the gasoline content. In practice the effect appears to be neglible.

d) This predicts packing to be conducive to hydrate formation, which has been found to be true.[4]

[4] G. A. Burrell and N. C. Turner—Natural Gas, 14, 3. June, 1933.

[5] E. G. Hammerschmidt—Western Gas, 9, 9-11 and 29, December, 1933.

[6] C. E. Pickup—Western Gas, 11, 31-32. October, 1935.

[7] "Water Vapor in Natural Gas," by C. H. M. Burnham—American Gas Journal, 131, 29-31. June, 1932; 137, 32-34. July, 1932.

How to Cut Flat Oil Field Belts

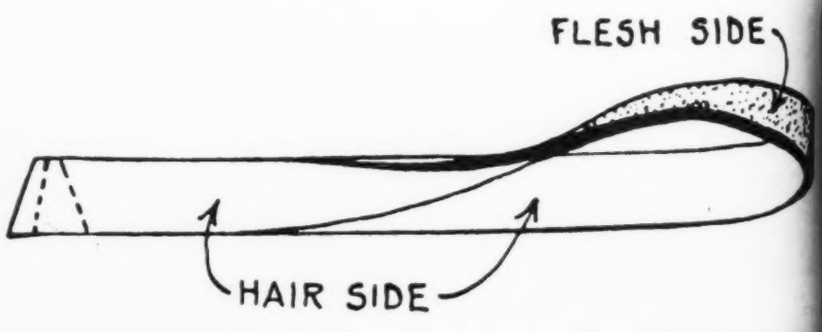
By W. F. SCHAPHORST

A VALUABLE kink for cutting flat belts is illustrated in the sketch herewith. The kink, it appears, is not known to most belt users, so it is given here.

When cutting a belt, the old method is to use a square and make the cut "absolutely square" with the sides of the belt; however, if done in the manner illustrated here it is not necessary to make the cut square. The most important thing is simply to make the cut "straight."

To do this, give the belt one turn, as shown in the sketch, and lay the ends one exactly over the other, both in perfect alignment. Then, by making the cut "straight" even though not square with the sides, it will be found that the ends will make a perfect fit. The cut may make an angle of 45 deg. or even more with the sides. The angle makes no difference.

It is, of course, best practice to cut the belt square, or as nearly square as possible. By cutting it square belting material is more likely to be saved than when the cut is made at an angle. To be sure about it, even if a square is used, it is an excellent safety measure to give the belt one turn as explained here and then if the square itself is not true, or if an error has been made in some way or other, the error automatically will rectify itself.



The $100,000,000.00 World Oil Show in Houston, October 11-16, will present to oil men the world over the greatest educational display of equipment and methods ever assembled under one roof. Note here some of the attractions offered for your interest:

NEW EQUIPMENT

● New designs, many never before shown, of modern equipment for exploration, drilling, production, pipe line, refining and gasoline plant.

EQUIPMENT IN OPERATION

● Application of new designs and improvements, including the actual drilling of several holes . . . the demonstration of gun perforators, formation testers, geophysical instruments, modern coring units, and many other interesting developments.

LATEST DEVELOPMENTS IN PIPE LINE CONSTRUCTION

● The latest development in pipe line building, including welding methods, pipe handling, cleaning, coating and wrapping equipment in action.

METALLURGICAL DISPLAYS

● Steel and metallurgical displays, including single exhibits costing more than $10,000 to prepare.

NEW INVENTIONS

● Inventors section, where free space will be devoted to introducing new products developed but not yet on the market.

CONVENTIONS

● Meetings, such as the annual national convention of the Independent Petroleum Association of America, the American Gas Association convention, and others.

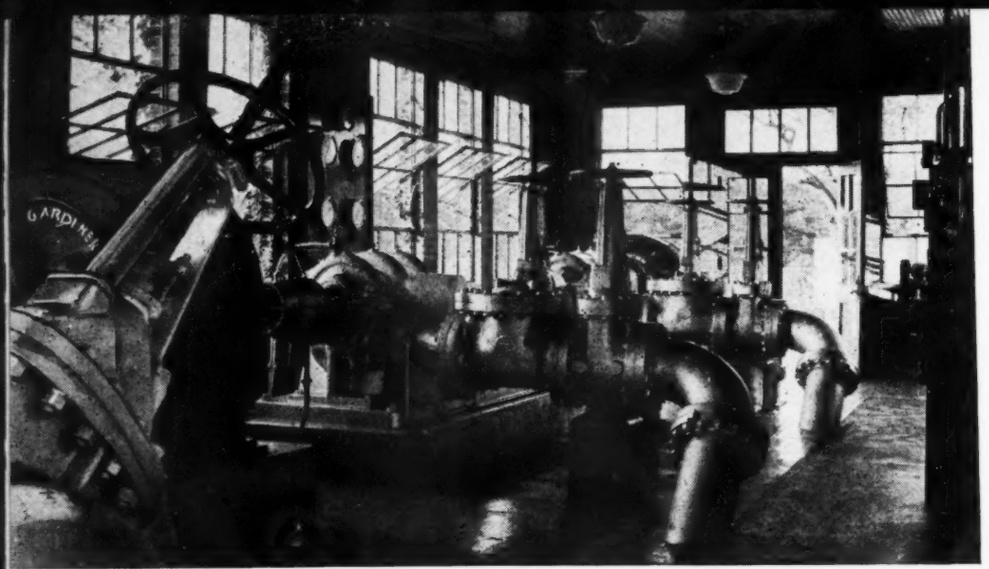
TECHNICAL MEETINGS AND CONTESTS

● Technical meetings, including the Directional Drilling Meeting, Export Committee Meeting of Foreign Buyers and Manufacturers, Technical Refinery Meeting, Conference on Refinery Measurement and Control, Safety Meeting, National Petroleum First Aid Contests, Production Committee Meeting, and a meeting devoted to Drilling Development.

ENTERTAINMENT FEATURES

● Entertainment, including the Annual Oil Men's Dinner; Safety Engineer's luncheon and dinner; Motion pictures by the U. S. Bureau of Mines; and other technical and educational films; U. S. Army searchlight demonstration; several large bands.

» REDUCED RAILROAD FARES FOR OIL MEN «



Interior of Reclamation Supply Corporation's pipe line station, showing motors, centrifugal pumps, and suction and discharge connections, including gate valves and 250-lb. flanged ells

By
J. C. ALBRIGHT

Providing Water for Water-Flooding Operations

Considerable capital is required to develop an adequate supply and to lay out a system for processing, distributing, and utilizing the water at the well

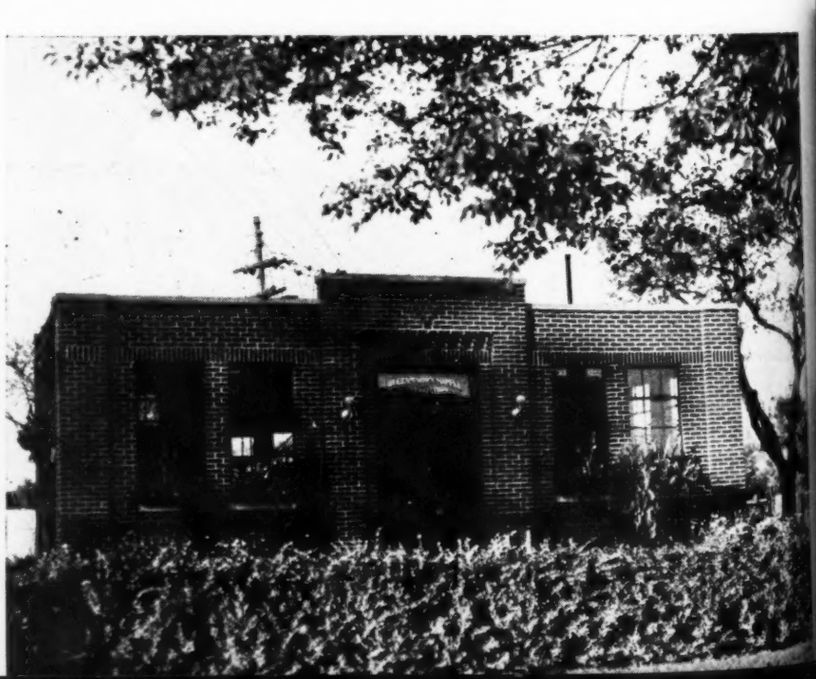
WATER is of prime importance in water-flooding operations for the recovery of oil. Considerable capital is required to develop an adequate supply and to lay out a system for processing, distributing, and utilizing the water at the wells. Even in Pennsylvania and southern New York State, where the water supply is unusually good, a large investment for a water system is necessary. Many of the smaller companies engaged in water-flooding operations in the Bradford district of northwestern Pennsylvania and around Olean in New York State, obtain their water supply from shallow wells drilled on or near the properties being operated. Others, engaged upon large-scale projects, find that the local supply of water is not sufficient to guarantee continuous operation the year around.

Petroleum Reclamation Corporation, being one of the largest operators of flooded properties in the Bradford field, supplies water for its own needs in addition to those of others not so fortunately situated. Through a subsidiary company, Reclamation Supply Corporation, practically all the water injected into the oil-bearing sands of properties operated by the Corporation is produced in New York State, and is obtained from wells excavated beside the Allegheny river, near Allegheny, New York. The wells are comparatively shallow, and produce from a water-bearing gravel, which provides an abundant supply of water that is practically uncontaminated by foreign matter. Produced as it is through a natural filter bed, the water requires no additional treatment, either by subsequent filtration or chemical treatment with lime or other materials before being pumped through the injection wells into the producing sands.

Electric power is used exclusively to pump the water from the wells to a supply reservoir, from which point the water is sent by pipe line to the field several miles to the southeast. Comparatively high-voltage current is employed at the motors, being stepped down from the transmission line to 2300 volts at the switches. Three motor-driven units were installed in this initial, or main, station of the water pipe line. Two of the units consist of a 250-hp., 3-phase, 60-cycle, 2200-volt, 1760-r.p.m. motor, connected to a multi-stage centrifugal pump whose capacity is 1200 gal. per min. against a 525-ft. head and operating at 1760 revolutions per minute. The other unit is powered by a 400-hp., 2300-volt, 3-phase, 60-cycle, motor connected to an 8 by 6 pump with a capacity of 2100 gal. per min. operating at 1770 revolutions per minute. All pumps are connected at the discharge to a 24-in. pipe line leading to the field.

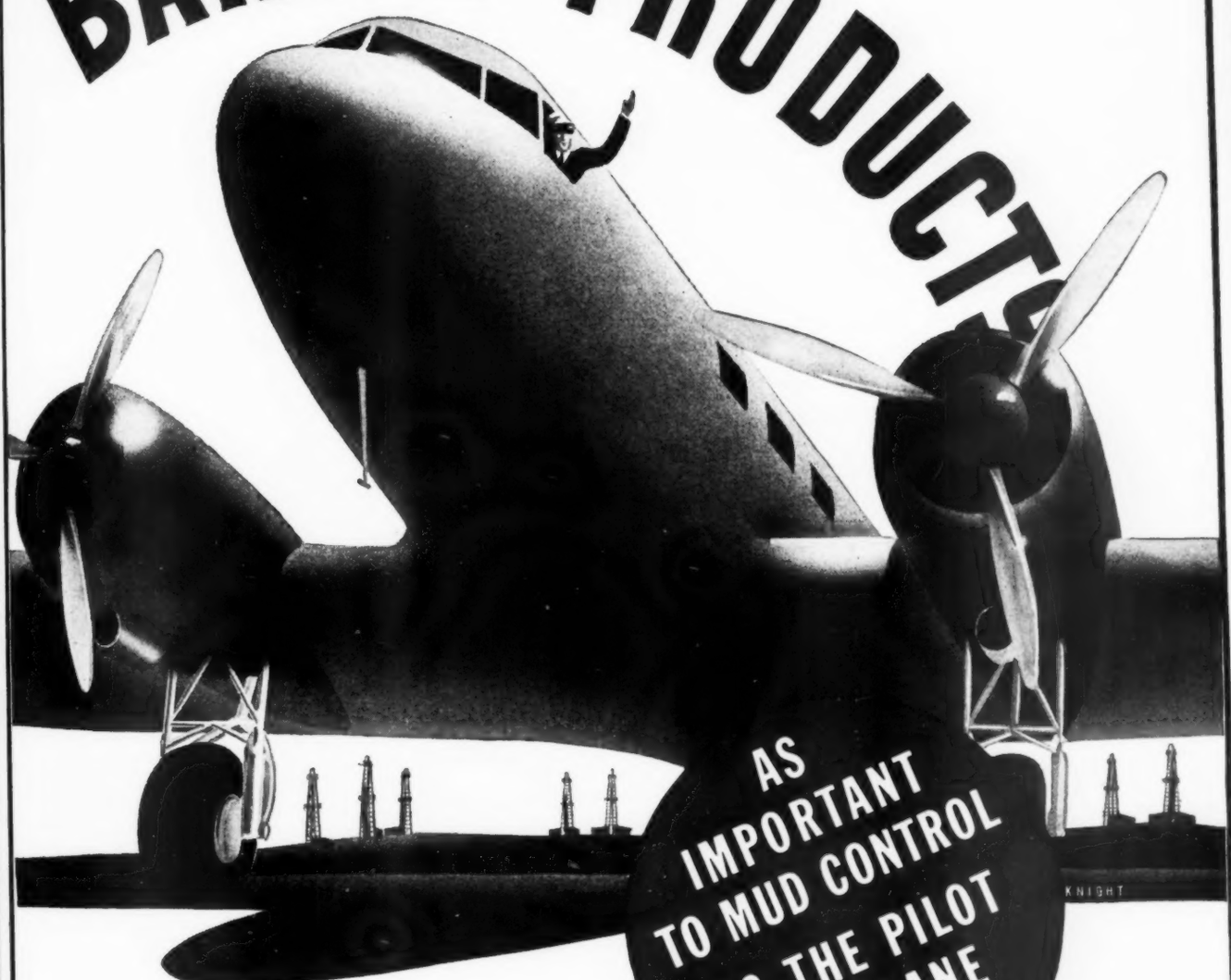
The delivery capacity of the water station is 5000 gal. per minute. Several of the properties obtaining water from this station are operated at a pressure so low that the pipe-line pressure is sufficient for injecting the required volume into the sand through the injection wells.

The estimated cost to produce and transport water by large-capacity pumps and pipe lines in the system of the Reclamation Supply Corporation is between one and two cents per thousand gallons.



Main office and pipe line station of Reclamation Supply Corporation, situated across the Allegheny River from the town of Allegheny, New York. A large portion of the water used in Bradford, Pennsylvania, for water-flooding is supplied from this station

BAROID PRODUCTS



AS IMPORTANT TO MUD CONTROL AS THE PILOT TO PLANE CONTROL

Many oil operators would no more drill a well without using BAROID Products than an Air Line would send up a ship without a pilot.

The pilot has every modern, proved aid to air control; the oil operator who uses BAROID Products *has every modern, proved aid to mud control.* Lack of control in both ship and mud may mean disaster!

BE SAFE! Use BAROID Products—the mud conditioners used in thousands of wells—the answer to drilling mud control. Stocks and Service Engineers are in all active oil fields.

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LAUGH WITH BARNEY

Edited by BARNEY HORRIGAN

Contributions

Pat, Sandy, and Isaac planned a picnic, and it was arranged that each was to bring something. On the day of the outing Pat brought some ham, Isaac brought the bread, and Sandy brought his family.

* * *

Hotel Proprietor: Do you want the porter to call you?

Guest: No, thank you; I awaken every morning at seven.

Proprietor: Then would you mind calling the porter?

* * *

Ho! Hum!

The club bore was relating one of his long-winded stories that everybody knew by heart. He was describing what happened to him when he went on a trip to Grand Canyon in America during a world tour.

"The soft curtain of night was just falling," he orated. "There I stood, drinking in the scene, with the giant abyss yawning before me."

One of the listeners interrupted at this point. "I say, old chap," he asked, "was that abyss yawning before you got there?"

* * *

Four long years he worked and sweated,
Labored conscientiously,
Crammed for tests and wrote his papers,
Then he won his Phi Beta key.
Now he's working at a counter,
And while waiting to make sales
Reaches for the gold insignia
And calmly cleans his finger nails.

S. Calif. Wampus.

* * *

A doctor has got off a good one which will appeal to everyone worried about highway crossings. He says:

"A foot on the brake is worth two in the grave."

* * *

"It is hard," remarked Mrs. Starvem at the dinner table, "to think that a poor little lamb had to be destroyed in its youth just to cater to our appetites today."

"Yes," replied the boarder, struggling with his portion, "it is tough."

* * *

Mrs. A.: Has your husband given up golf?

Mrs. B.: Yes, but he still uses the language when changing tires.

The newcomer knocked on the pearly gates and St. Peter's voice called, "Who's there?"

"It is I," answered the newcomer.

"Well, get out. We don't want any more school teachers."

* * *

Safety First

Greatly agitated, a woman carrying an infant dashed into a drug store.

"My baby has swallowed a bullet!" she cried. "What shall I do?"

"Give him the contents of this bottle of castor oil," replied the druggist calmly. "And then be sure you don't point him at anyone!"

* * *

Man (employed by a Scotchman): I have been around here ten years, sir, doing three men's work for one man's pay, and now I want a raise.

Employer: I canna gie ye that, but if ye'll tell me the names of the ither two men I'll fire 'em.

* * *

Neighbor: And how is your poor husband this morning?

Mrs. Murphy: Yesterday he was enjoying poor health, but today he complains of feeling better.

* * *

Girl Friend: I'm getting so thin you can count my ribs.

Boy Friend: Gee! Thanks!

* * *

"Could I interest you in a Studebaker?"

"Lady, you could interest me if you were in a second-hand flivver."

* * *

"Darling, if you refuse me, I shall never love another."

"That's wonderful, but will that hold good if I accept you?"

* * *

"And what is the child's name?" asked the minister.

"Shirley," replied the mother.

"Shirley?"

"Yes, after famous Shirley Temple."

"Let me see," said the minister. "Who is the preacher there now?"

* * *

Ruby: Do you resist the boys when they try to kiss you?

Dorothy: Yes, but I'm not very strong.

* * *

Bill: Was it crowded at the party last night?

Sill: Not under my table.

The Worm Turneth

An Indian in Oklahoma, hard up, went to the bank to borrow $100. The banker said it would be all right, provided he had some security. The deal finally was made, the Indian giving a mortgage on twenty ponies.

Not long after that oil was struck close to the Indian's allotment, and he sold his oil lease for a lot of cash; so he stepped into the bank and peeled off a $100 bill to repay the loan.

"That's fine," remarked the banker when the business was completed, "but you don't want to carry all that money around with you. Better leave it here with me."

"All right," replied the redskin, "how many ponies you got?"

* * *

The fellow had been handed a box of cigars as a reward for a favor. Meeting him a few days later, the donor asked how he had enjoyed the smokes.

"I smoked the first cigar and thought it was awful—until I found I had forgotten to remove the cellophane," stated the fellow. "Then I smoked the second cigar without the cellophane. That one was so bad that the third time I just smoked the cellophane."

* * *

Beneath this stone lies Murphy,
They buried him today;
He lived the life of Riley—
While Riley was away.

* * *

A small boy, on being asked how his uncle always won when he played cards, but lost when he backed horses, promptly answered: "Uncle can't shuffle the horses."

* * *

A young boy, undergoing an examination for position, came across the question, "What is the distance of the earth from the sun?" He wrote his answer as follows: "I am unable to state accurately, but I don't believe the sun is near enough to interfere with a proper performance of my duties if I get this clerkship."

He got it.

* * *

A farmer met his hired hand carrying a lighted lantern and asked him where he was going. "A sparkin'," was the reply. "When I was young," said the farmer, "I always went in the dark." "Yes," replied the hired man, "and look what you got!"

THERE IS

TO PERFORM A CEMENT JOB

...AND THAT'S THE *First* TIME!

Use of a BAKER CEMENT WHIRLER FLOAT SHOE insures maximum chance for success of that all-important initial cement job by providing the ultimate in cementing efficiency.

The Baker Cement Whirler Float Shoe differs from ordinary types of cement shoes in that in addition to a bottom circulation hole*, it is designed with a number of baffled side ports which direct the cement slurry upward with a whirling motion. (See illustration). This upward spiral movement insures uniform distribution of cement for a greater distance up and around the casing, resulting in a better cement job, with far less danger of channeling.

*A variation of this device is the Baker Cement BULL PLUG Whirler Float Shoe—made with a SOLID, guide shaped cement bull plug which extends below the shoe. All of the cement is thus diverted through the baffled side ports and directed upward with a whirling motion. This type is used ONLY in wells which have been properly prepared and conditioned, since the absence of the bottom circulating hole makes it impossible to wash down should it become necessary.

OF COURSE IT'S ALSO an EFFICIENT FLOAT SHOE

While the Baker Cement Whirler Float Shoe is primarily a cementing shoe, it is also a strong, safe, guiding and floating shoe. It possesses the 3 Baker Features, in a perfectly balanced combination . . .

1. *STRENGTH*

It is stronger than the collapsing strength of your casing—safe for strings of any length.

2. *VALVE EFFICIENCY*

A Bakelite valve chamber is provided, having ample circulation areas, with a buoyant Bakelite ball which floats in rotary mud or cement slurry, double-sealing against a rubber ring (backed by Bakelite and concrete) with the slightest reversal of pressure.

3. *DRILLABILITY*

Baker Cement Equipment affords complete drillabilty as No Metal ever is used for the internal construction of plug or valve. The entire assembly is constructed of special Baker-Formula Concrete and Bakelite and is easily drilled OUT and drilled UP into small, harmless fragments and circulated out of the hole. There is no metal left in the hole to prevent coring directly below the shoe, or to deflect the bit and start a crooked hole.

Write for the large Baker Catalog, or refer to the Baker Section in your 1937 Composite Catalog.

BAKER OIL TOOLS, INC.

Telephone JEfferson 8211 – HUNTINGTON PARK, CALIFORNIA – 2959 E. Slauson Ave.
Telephone WAyside 2108 – HOUSTON PLANT AND OFFICE – 6023 Navigation Blvd.

MID-CONTINENT OFFICE AND WAREHOUSE:
Telephone 2-8083 – Tulsa, Oklahoma – 312 East Fourth Street

WEST TEXAS BRANCH OFFICE
Odessa, Texas – Telephone 217

EXPORT SALES OFFICE
Rm. 1914 – 19 Rector St., New York City
Tel. Digby 4-5515

ROCKY MOUNTAIN HEADQUARTERS
Tel. 2230-Casper, Wyoming – Box 1464

BAKER CEMENT WHIRLER FLOAT SHOE

Running Tour
WITH MEN IN THE INDUSTRY

J. N. BISH, production superintendent in the Haynesville, Louisiana, field for the Ohio Oil Company, retired July 1st after 50 years of service with the company. He was succeeded by O. V. Henry.

H. L. MONTGOMERY, Bartlesville, Oklahoma, has resigned as president of the board of directors of the American Pipe Line Company, subsidiary of the Cities Service Gas Company.

R. B. HECOX, safety engineer for the Standard Oil Company of California, who has been stationed at Bakersfield, has been transferred to San Francisco. **W. E. LOVEJOY,** his assistant, takes over the work at Bakersfield.

GUY STEVENS, European representative of the Gulf Oil Corporation and director of the Kuwait Oil Company, recently made a business trip to the United States. He is now back at his headquarters in London, England.

CARL W. DAWSON, engineer in the maintenance department of the Standard Oil Company of California, has been transferred from Bakersfield to Los Angeles. He has been succeeded by **R. J. VILLIGRANA.**

L. A. BUSHE has been made assistant manager of Apex (Trinidad) Oilfields, Ltd., to succeed **H. D. FLETCHER** who became manager recently upon the retirement of **H. C. B. HICKLING.**

J. A. STARKEY, district superintendent at Hobbs, New Mexico, for the Amerada Petroleum Corporation, has resigned and become connected with the Two States Drilling Company.

J. B. MERRITT, who has been field superintendent for the Honolulu Oil Corporation at Elwood, California, has been transferred to Midland, Texas, where the company has holdings.

CHARLES H. STEARNS, who has been subforeman for the Carter Oil Company at Duncan, Oklahoma, has been promoted to production foreman to replace **R. E. EBY** while the latter is in Wyoming.

JOHN F. DODGE, professor of petroleum engineering at the University of Southern California, is on a tour of the world. While away he will visit many foreign oil fields.

T. A. MORGAN has resigned as director of oil conservation in Kansas to return to private business. His resignation was effective July 1st. He has been succeeded by **E. G. DAHLGREN,** who has been chief clerk of the Oklahoma Corporation Commission.

SHERMAN NELSON, president of Hantho-Nelson, Inc., has moved offices of the company from Luling to San Antonio, Texas.

FELIX MENDOZA has joined the staff of the Magnolia Petroleum Company and been assigned to petroleum engineering work in the Fitts pool, Oklahoma. He is a post graduate student at the University of Oklahoma.

RUFUS D. HODGE, who has been an operator at the Francis, Oklahoma Pipe Line Company, has been made an engineer-operator and placed in charge of the Carney station.

EDWIN B. COX, of Edwin B. Cox & Jake L. Hamon, of Ardmore, Oklahoma, and Dallas, Texas, sailed from New York July 7th on the "Queen Mary" for a tour of Europe with Mrs. Cox. They will return about September 1st.

R. L. MARSTON, superintendent of production in the Rio Grande City district of South Texas for the Sun Oil Company, has been sent to Aberdeen, Washington, to take charge of the drilling of a deep wildcat test near Forks, Washington.

GEORGE A. DONNELLY, head of Eastland Oil Company, Fort Worth, Texas, and **HUGH G. WHITE** have organized the Hudon Oil Company. They will operate in Southwest Texas.

W. J. HEALEY, of the Healey Petroleum Corporation, Bradford, Pennsylvania, has been elected to the board of directors of the Pennsylvania Grade Crude Oil Association.

J. V. HAYWOOD, who has been stationed at Wilson, Oklahoma, for the Carter Oil Company, has been transferred to the production department of the Standard Oil Company of Venezuela. His headquarters will be at Caripito, Venezuela.

DWIGHT C. McCABE, president of the Golden Petroleum Company, has transferred headquarters of the company from San Angelo to Abilene, Texas.

JOHN V. STUCK, drilling foreman of the Standard Oil Company of California, is visiting his old home at Oil City, Pennsylvania, which he has not seen for 30 years.

ROGER W. RICHARDSON, who has been a member of the technical staff of the Standard Oil Company of Louisiana at the Baton Rouge refinery, was placed in charge of research work on motor oils at the Elizabeth, New Jersey, laboratories of the Standard Oil Development Company, effective July 1st.

ELDON N. DUNLAP, Austin, Texas, recently received his Masters degree from the Massachusetts Institute of Technology. Prior to entering M.I.T. he had received a Bachelor of Science degree from the University of Texas and had been on the staff of the Humble Oil and Refining Company.

CHARLES R. KELLY, Tampico, Mexico, foreman of the Prieto Terminal of the Mexican Gulf Oil Company, spent his vacation with relatives in Texas.

DON WEST, head of the natural gasoline department of the Magnolia Petroleum Company, Dallas, Texas, went to Colorado for his vacation this year.

W. C. O'FERRELL, El Dorado, Arkansas, who resigned recently as vice-president in charge of production for the Lion Oil Refining Company, is now associted with **E. M. JONES,** Texas and Arkansas operator. O'Ferrell's headquarters will be at San Antonio, Texas.

MASONEILAN REGULATORS STAY ON THE JOB

Year after year, out in the field where shut-downs are particularly costly, Masoneilan Regulators are doing the work for which they are built — setting new standards of dependability.

The reason is that Masoneilan equipment is built up to the job—not down to a price. Correct design, highest quality materials and precision workmanship, backed by over half a century of practical experience insure Masoneilan equipment staying in the line and out of the repair shop.

Specify Masoneilan Regulators for gas, oil, water or steam service under all operating conditions. Write your requirements to our nearest office.

MASONEILAN

MASON-NEILAN REGULATOR COMPANY, 1193 ADAMS STREET, BOSTON, MASS., U. S. A.

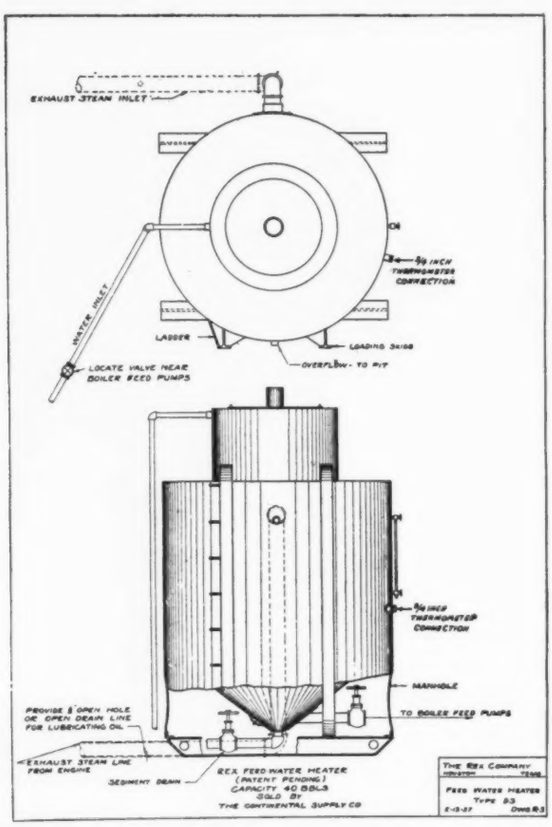
New York Philadelphia Pittsburgh Chicago Tulsa St. Louis Houston Los Angeles

MACHINERY and EQUIPMENT

Rex Company Designs Pre-Heater for Use On Oil-Field Boilers

THE Rex Company, Houston, Texas, has placed on the market, through Continental Supply Company, a new open-type feed-water heater for use with oil-field boilers.

According to the manufacturer, the Rex Pre-Heater was designed not only to provide ample 200-210-deg. boiler feedwater, but, of even greater importance, to remove all sediment from the water before it is delivered to the boilers. It is claimed that by so removing sediment from the water the boiler tubes will remain clean for a longer period of time, resulting in increased efficiency of the boilers and reduction of maintenance to a minimum. Provision is made for trapping and drawing off sediment that settles out of the water. Being an open-type heater, it liberates any oxygen dissolved in the water before it enters the boilers, thus eliminating the corrosive action of free oxygen on the boiler tubes.


EXHAUST STEAM INLET
¾ INCH THERMOMETER CONNECTION
WATER INLET
LADDER
LOADING 24x108
LOCATE VALVE NEAR BOILER FEED PUMPS
OVERFLOW - TO PIT
¾ INCH THERMOMETER CONNECTION
MANHOLE
PROVIDE ⅛ OPEN HOLE OR OPEN DRAIN LINE FOR LUBRICATING OIL
TO BOILER FEED PUMPS
EXHAUST STEAM LINE FROM ENGINE
SEDIMENT DRAIN
REX FEED WATER HEATER (PATENT PENDING) CAPACITY 40 BBLS SOLD BY THE CONTINENTAL SUPPLY CO
THE REX COMPANY
FEED WATER HEATER TYPE DS
DWG. #3

The Rex Pre-Heater, utilizing exhaust team from the engines, transfers heat directly from the steam to the water. The accompanying illustration shows the simplicity of design and directions for installing the heater. There are no trays or hoppers to clean, and no leveling is required. A thermometer and two 4-in. screw-end gate valves are provided as standard equipment.

The Rex Pre-Heater is of rugged construction, being designed especially for oil field use. It is mounted on heavy I-beam skids. Additional skids are provided on one side of the heater to facilitate loading on trucks.

The manufacturer has designed this product as the Rex Pre-Heater Type "DS", offering it in capacities of both 40 bbl. and 90 barrels. For fully descriptive literature, address your request to The Rex Company, P. O. Box 2431, Houston, Texas.

Koroseal Paper

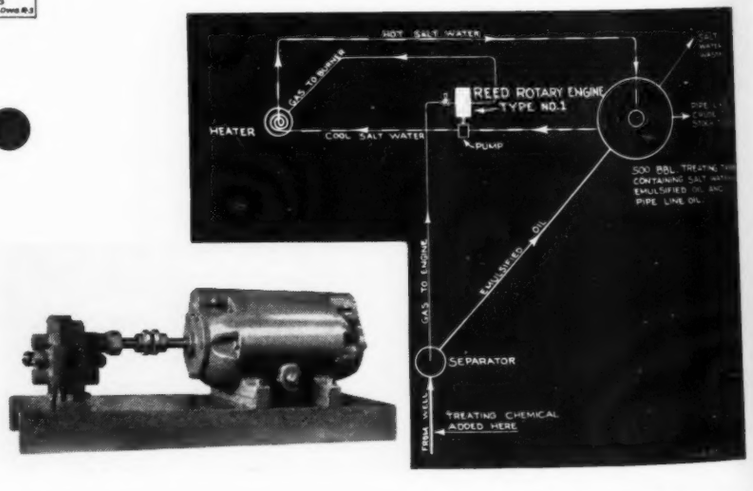
THE most recent use developed for Koroseal, a synthetic elastic developed by the laboratories of The B. F. Goodrich Company, Akron, Ohio, is its application to paper. This paper consists of a thin coating of pure Koroseal applied with strong adhesion to one side of a high-grade 40-lb. kraft paper. It is suitable for any service where a waterproof, oilproof, greaseproof, airtight, or sanitary paper is required, its makers state.

The Koroseal coating will flex as long as the paper and will not crack. Addition of this tough film increases the tear resistance of the paper.

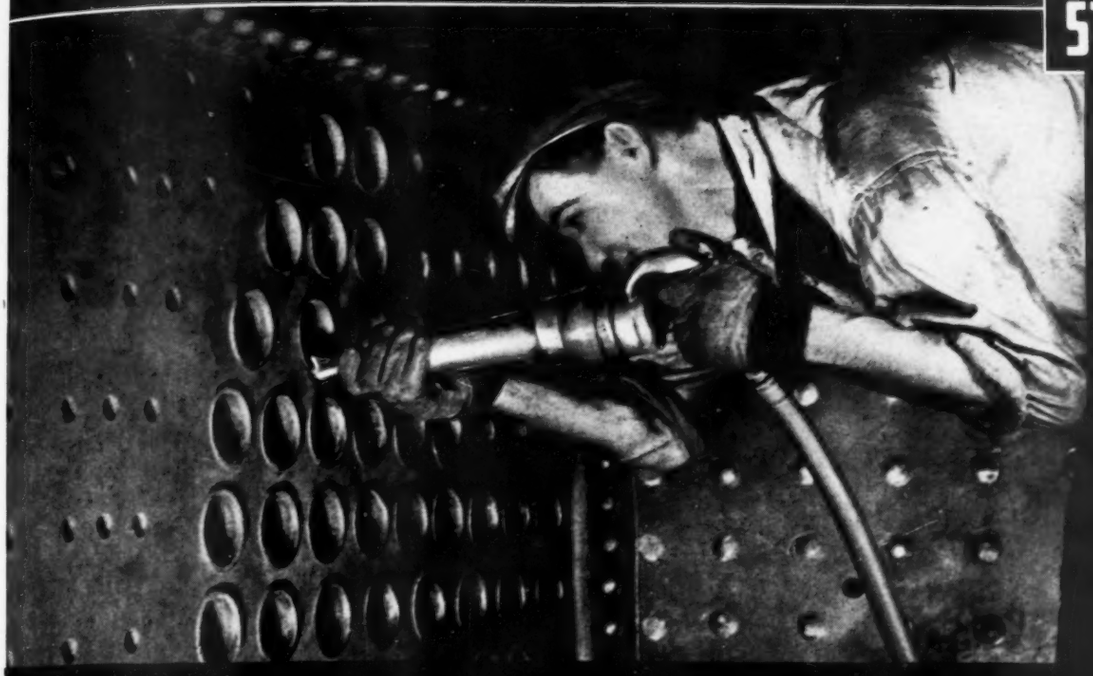
Treating Unit

THE Reed Roller Bit Company, Houston, Texas, has announced a new Bronze Gear Pump Treating Unit, which consists of a Reed rotary engine direct-connected to a bronze gear pump, mounted upon a metal base. This unit operates on gas pressure from the separator, driving the pump that circulates salt water from a treating tank, through a heater back into the tank. The exhaust gas from the engine is burned under the heater, therefore no gas is wasted.

A more flexible control of the temperature of the treating system is claimed. The use of a forced circulating system for treating, rather than a thermo-syphon, results in the elimination of frequent repairs to the heater and deposition of salt in the heater and lines.



Increase your profits with J&L STEEL



J&L *Seamless Boiler Tubes*

stand up under heat, vibration and corrosion

. . . and they are easily installed

J&L Seamless Steel Boiler Tubes assure maximum safety and long life because they are strong and durable. They have unusual toughness and uniform metal density to resist the destructive forces of heat, vibration and corrosion. Because they are more ductile, they roll-in faster. They save you time and money.

The forging action which characterizes the Jones & Laughlin method of seamless manufacture *increases* the strength, toughness and workability of the steel. There are no welds . . . no weak spots . . . therefore there can be *no failure at or near a weld.* Inspection during every stage of manufacture assures uniform high quality tubes that give lasting satisfaction.

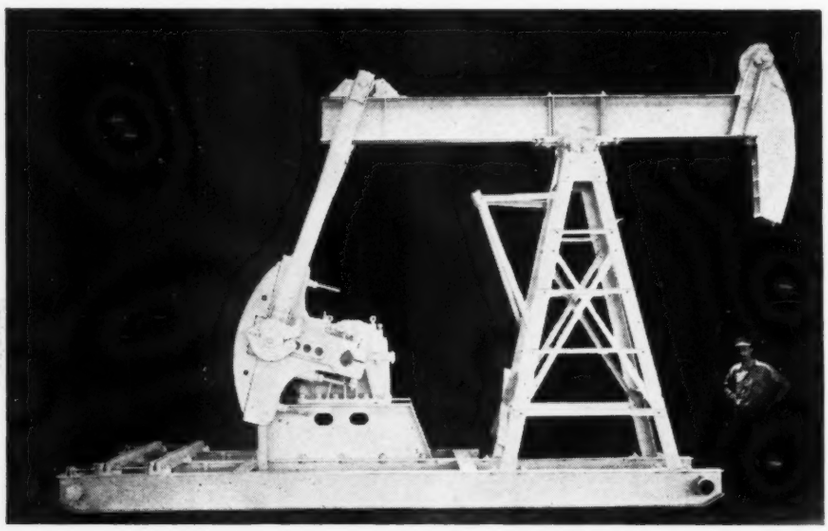
Steam power plants, boiler makers, railroads and shipyards throughout America rely on J&L Seamless Boiler Tubes. For lower maintenance costs and quick, easy installation specify and use Jones & Laughlin Seamless Boiler Tubes. Call your local Jones & Laughlin boiler tube distributor.

JONES & LAUGHLIN STEEL CORPORATION

PITTSBURGH, PENNSYLVANIA

MAKERS OF HIGH QUALITY IRON AND STEEL PRODUCTS SINCE 1850

Pumping Unit by International Supply



AN IMPROVED pumping unit, combining the manufacturing skill and facilities of a pioneer oil-field equipment manufacturer with the practical field experience of the oil industry, is announced by International Supply Company. The "ISCO" Pumping Unit, has easy portability, quick installation features, and low operating costs, the manufacturers say. It is especially designed for strength, capacity, and flexibility to meet the growing and varied conditions of the industry, it is stated.

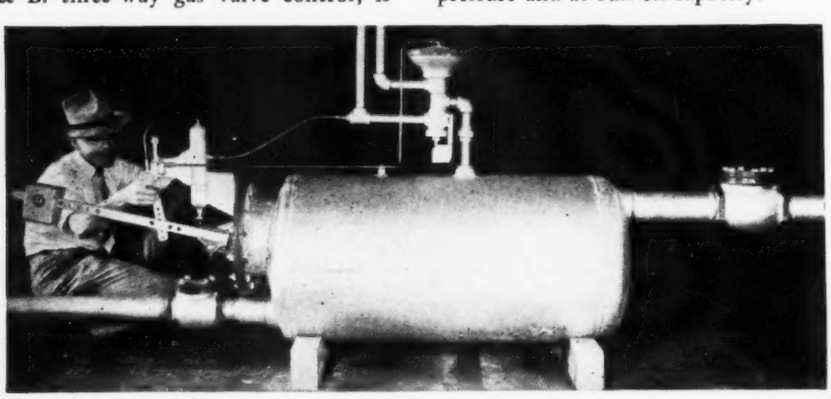
The features of the "ISCO" Pumping Unit include weather-proof oilbath lubrication, enclosed grease-packed bearings, gas, gasoline, Diesel or electric power, centralized operators control of clutch and brake, adjustable countershaft, ample clearance for well servicing, based on A.P.I. capacity walking beam and gear box, derrick-type sampson post, both rig front and back installation, hp. 10 to 50, long stroke for high recovery and low cost, main skid accommodates prime mover, short base for separate engine mounting, removable arc-type horsehead and underslung type hanger, welded construction.

Polished rod loads are of 8,000 lb., 12,000 lb., 17,000 lb., and 22,000 lb., with corresponding stroke ranges of 21 in. to 36 in., 24 in. to 54 in., 24 in. to 64 in., and 24 in. to 74 in., respectively.

B. S. & B. Automatic Blow Case

Black, Sivalls and Bryson, Inc., Oklahoma City, Oklahoma, have announced a new automatic blow case for boosting oil into stock tanks from separators working at low pressure. The equipment also is said to be ideal for use as an automatic drip in wet gas lines operating under vacuum. The apparatus is equipped with a special B. S. & B. three-way gas valve control; is strictly automatic and requires no attention; is operated on a small volume of gas from outside source; and the separator cannot flood.

The capacity of the blow case is 1000 bbl. of oil each 24 hours. Gas required is 24.4 cu. ft. per dump, or 24,400 cu. ft. each 24 hours, free gas, when operating at 25-lb. per sq. in. pressure and at full oil capacity.



Permobond Corrosive-Proof Protective Linings

UNITED States Rubber Products, Inc., New York City, announce that its Permobond corrosive-proof protective linings are now available for practically every kind of service.

Permobond, first developed in 1924, has reached, through the extensive advances made in the compounding of rubber and the perfecting of the bonding of rubber-to-metal process, a point where it offers distinct advantages over linings fabricated from other materials, the manufacturers say. It provides maximum resistance to corrosion, diffusion, abrasion, and electrical conductivity. For storage equipment Permobond insures freedom from mechanical difficulties, better uniformity of product, and freedom from contamination of product.

The success of Permobond linings is based on three things: (1), compounding the rubber to meet the specific problems of the job; (2), the permanent bonding of the lining to the walls of the tank; and, (3), the fact that Permobond linings are tailor-made and that no workman puts a hand to the job until U. S. Rubber engineers have planned it for design, facility of installation, and specification of rubber. The result is a job especially engineered to fit individual requirements plus a permanent leak-proof lining and a bond that is practically an integral part of the metal surface itself.

There are many classes of chemicals that may be handled more satisfactorily with rubber than with any other lining substance. Steel or wood containers, lined with rubber, will stand up in contact with these chemicals for a very long time. Without this protective covering the steel or wood would be quickly destroyed in many instances. For instance rubber properly compounded is inert toward:

(1) All inorganic acids except strong oxidizing acids.

(2) Most organic acids.

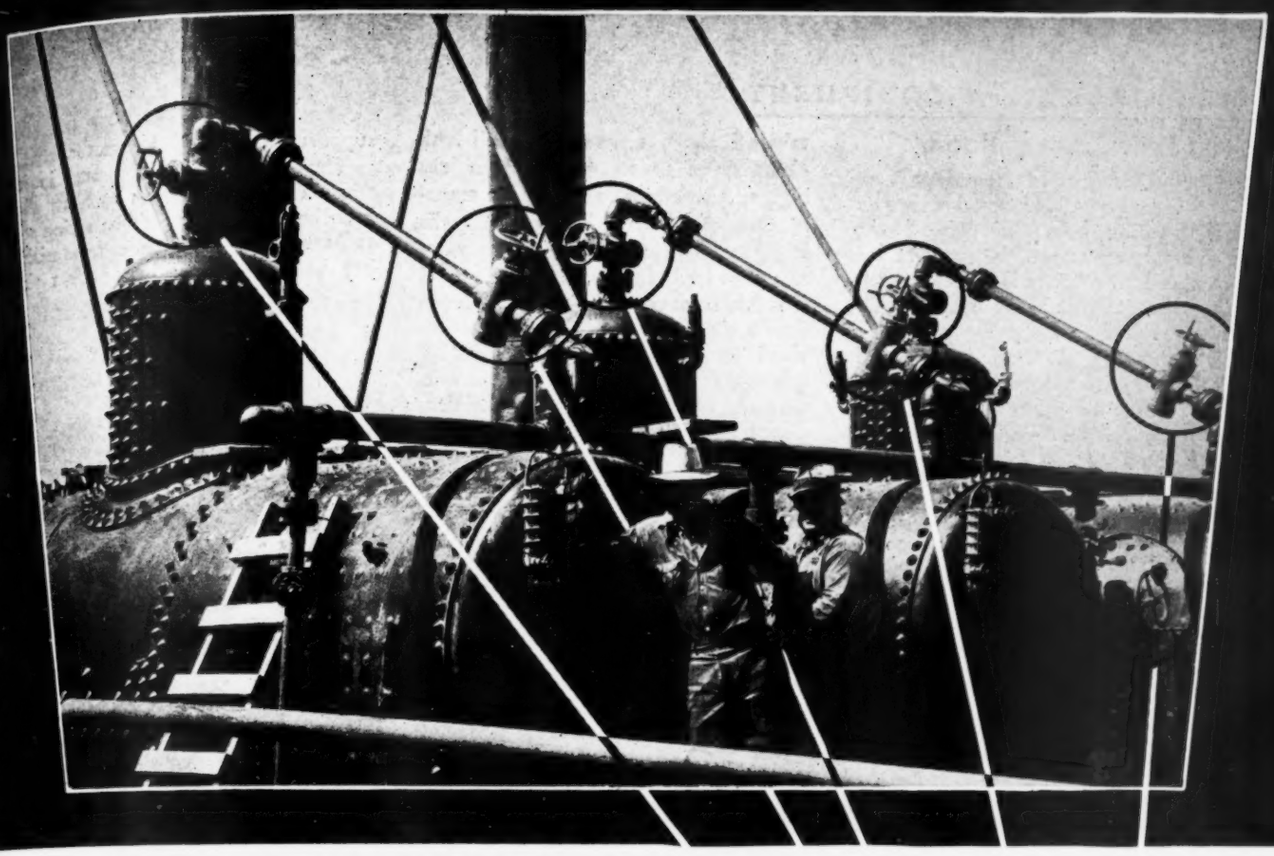
(3) Inorganic salt solutions.

(4) Inorganic bases.

(5) Plating solutions.

(6) Hypochlorite solutions and chlorine water.

Perhaps the best example of Permobond's use in connection with inorganic acids is as a lining in pickling and processing tanks, storage tanks, pipe and pipe fittings, and tank cars. It finds its most extensive use with organic acids in process storage equipment for handling tartaric acid.



The W-K-M SEMI-STEEL GATE VALVE
Is tops in the medium pressure range

The W-K-M Semi-Steel Gate Valve has all of those refinements of design and manufacture found in the W-K-M high pressure gate valve, such as (1) Less area exposed to pressure, (2) Through-conduit opening, (3) Seat faces not exposed to pressure or abrasion while in service, (4) Grease bath lubrication . . . and numerous other exclusive valve features.

The Semi-Steel type is made in 1600-pound and 2000-pound test pressures, for any kind of non-shock service.

There's a W-K-M Gate Valve type and size for every need. For full details refer to Bulletin No. 641.

It's different!

W-K-M Company, Inc.

OIL FIELD, PIPE-LINE & INDUSTRIAL EQUIPMENT

HOUSTON, Texas, U. S. A.

Export Office: 74 Trinity Place, New York

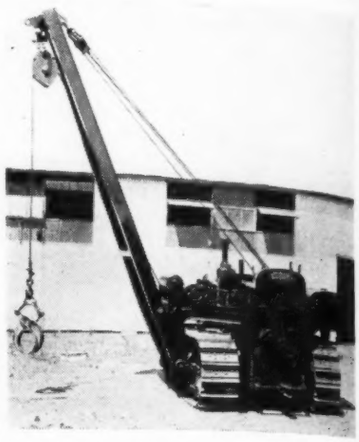
Cable Address: "WILKOMAC"

Pipe-Laying Boom

THE Muskogee Iron Works of Muskogee, Oklahoma, builders of well-servicing hoists and pipe-laying equipment, announces the new Model B-1 pipe-laying boom for International Harvester Company TA-40 and TD-40 TracTracTors.

The Model B-1 boom is equipped with a 5-speed transmission that allows a range of single line speeds of 22 to 342 ft. per min. with a single line pull of 24,000 to 3300 pounds. Both load and boom drums are free rolling and are mounted on stationary shafts. Power from the tractor engine is transmitted from the tractor power take-off shaft through an oil-bath chain drive to an extension of the high-speed shaft of the 5-speed transmission. A chain drive connects the low-speed shaft of the transmission to a countershaft on which is mounted clutches to operate the load and boom drums simultaneously or individually. The boom itself is designed with a wide opening at the top so that the 10-in. oil-bath self-aligning ball-bearing sheave can turn or swing as much as necessary without fouling the sides of the boom. The boom frame is made of heavy channels, welded together and securely bolted to large axles that transmit the load equally to the track support members of the tractor.

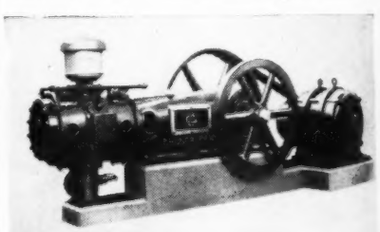
The boom has incorporated in it many desirable features, such as: oil-bath ball or roller bearings; spring attachment to prevent boom from sticking in upright position, perfect visibility from the driver's seat, adequate brakes to hold or release the load; provisions for sufficient counterweights to allow the use of the boom with heavy pipe; equal weight distribution; automatic release that prevents the boom from being pulled into the frame and either bent or broken; and simple rugged construction.



The B-1 boom has been field tested and is now ready for distribution.

Gardner-Denver Improved Compressor

THE Gardner-Denver Company, Quincy, Illinois, announces an improved single-stage, horizontal air compressor for heavy-duty full-load service and continuous operation at low power costs. Known as the "RX" compressor, it has totally-enclosed dustproof construction without sacrifice of accessibility, as well as accurate balance and freedom from vibration, the manufacturers state.



Another important feature of the "RX" compressors is the electro-pneumatic control. With this control the compressor always starts unloaded and the air supply is adjusted automatically to fit the air requirements, resulting in exceptional part-load economy. The compressors are equipped with Timken tapered adjustable roller main bearings.

Specify Spang

"HIGHER-STANDARD" CABLE TOOLS

and DRILL WITHOUT DELAY!

Fig. 516

STEM PIN (Heat-Treated)

Fig. 517

STEM BOX (Heat-Treated)

Delays in cable-tool drilling are frequently caused by the failure of mis-matched joints. Specify Spang for the entire string and you'll avoid costly shutdowns. They'll drill more footage and outlast any ordinary "mixture" of tools, because they're strictly "Higher-Standard" Cable Tools.

Consult SPANG about any cable-tool problem that arises.

The HIGHER STANDARD

SPANG & COMPANY, BUTLER, PA.

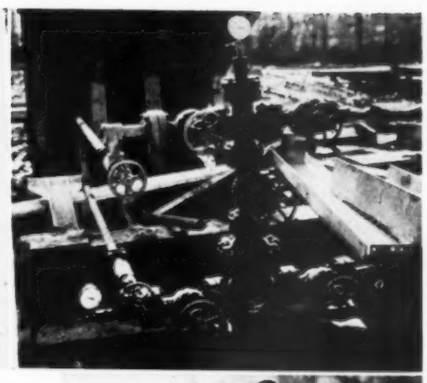
All-Metal Cementing Basket

GREATER strength, resistance to the action of acids, and adaptability to casing programs are among the advantages claimed for the new metal "petal" cementing basket, recently developed by Baker Oil Tools, Inc., 2959 East Slauson Avenue, Huntington Park, California. While the applications of this new basket as an aid in placing cement around casing are the same as those of the Baker canvas basket, it is constructed entirely of metal and incorporates several features that improve its operation.

A cementing basket serves as an outside packer during cementing jobs. It protects the formation from cement contamination and from sloughings of cavings, and aids in the cementing job by preventing any dissipation of the slurry that might occur. The new basket is made of a number of overlapping individual metal "petals" held in place with reinforced spring steel ribs. While running in, the petals fold inward closely around the casing and pass easily down the hole. When the casing comes to rest, the petals expand to their normal position, with the upper portion of the basket forming a seal against the wall of the hole.

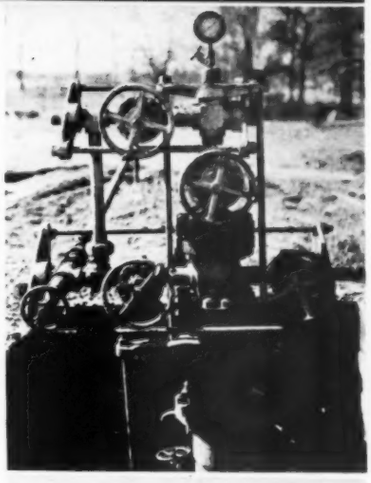
The petals are constructed of flexible sheet brass and are so designed that when fully expanded each petal overlaps the other by a sufficient margin to prevent the fluid above the basket from passing to the formation below. The reinforced spring steel ribs extend beyond the top of the petals and curl over above them. The spring tension of the ribs insures contact of the basket with the wall of the hole, while the overlapping petal design makes this contact conform to the contour of the hole without wrinkling.

Because of the overlapping of the metal petals, the basket folds closely around the casing while it is being run in the hole, a fact that recommends the use of the metal "petal" cementing basket in casing programs based on minimum clearances, the manufacturers state. Further details can be obtained from Baker Oil Tools, Inc.

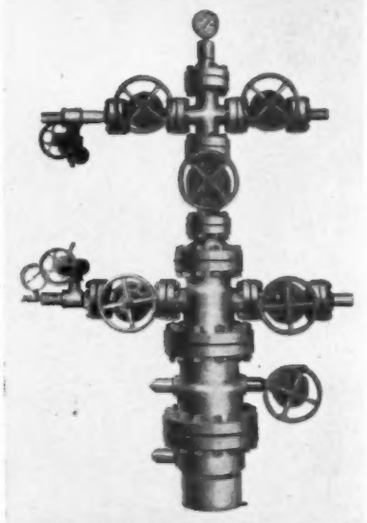


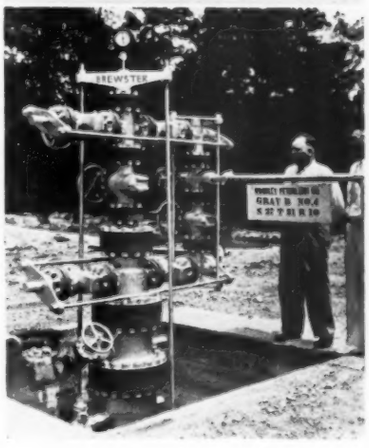
There's a Brewster Xmas Tree Well Assembly

. . . FOR ANY WELL
. . . ANY PRESSURE



Unlike the waitress who asked the customer what kind of apple pie he would have, our menu of Xmas Tree Well Assemblies is complete. Pictured here are some of 'em. Each one individually designed to fit the specific job. Pressure tested in our plant before it goes out on the location. All fittings and heads of alloy electric steel. Special high pressure gaskets used when necessary. Let us quote on your requirements . . . and remember . . . there's a BREWSTER Xmas Tree for any well —any pressure.





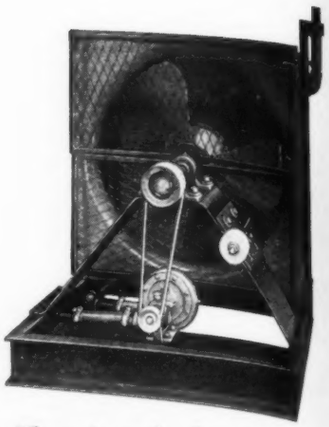
THE
BREWSTER
COMPANY, Inc.
PHONE 3181 SHREVEPORT, LA.
Houston, Longview, Lake Charles, New Iberia, Houma, Rodessa, Corpus Christi

Export Office: Acme Well Supply Company, 136 Liberty Street, New York City

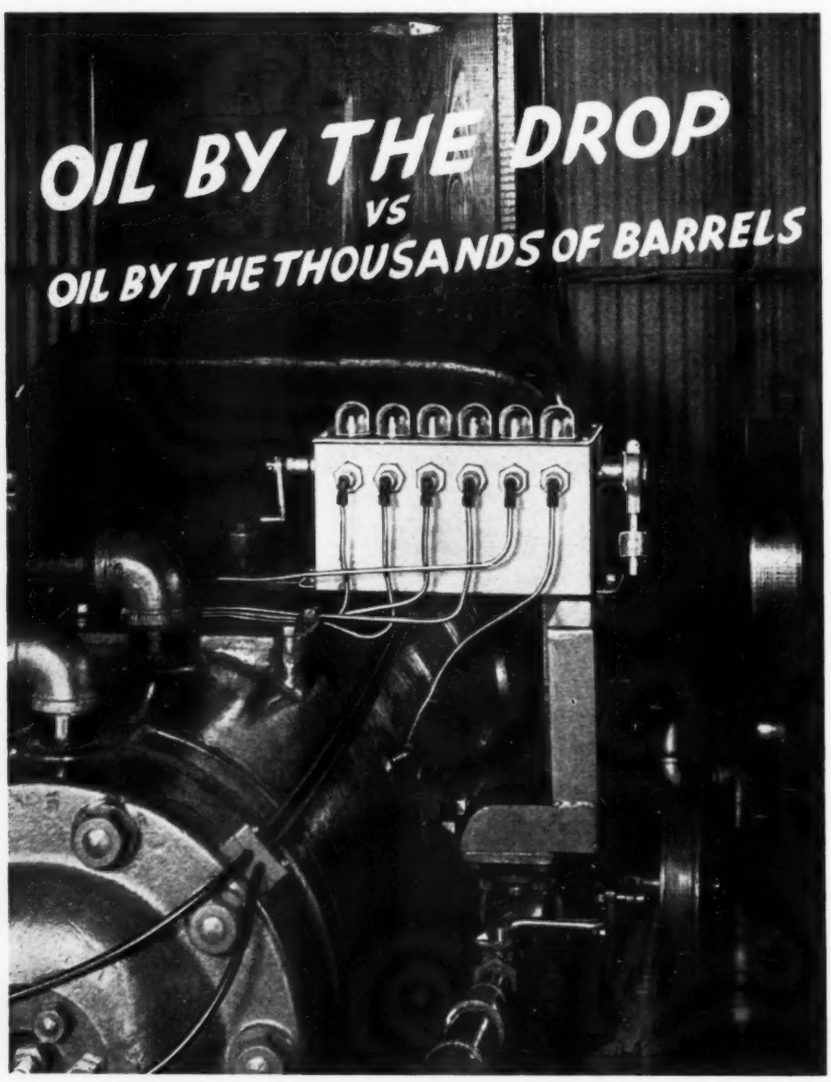
Engine Cooler by Chas. J. Franks Company

A NEW engine cooler that the manufacturers state takes the place of a circulating water tank, designed to give maximum efficiency in cooling internal combustion engines, is announced by the Chas. J. Franks Company, 316 East 11th Street, Tulsa, Oklahoma. The cooler is available in three sizes with a capacity for cooling engines ranging from 25 to 150 horsepower. A specially-designed fan forces air through the radiator, and where the radiator is centered in the engine house the air may be released through the ceiling. Radiators are made of copper and copper alloy with tubes of a double-lock construction withstanding 500-lb. pressure and specially treated to prevent corrosion.

The power required to drive the radiator fan and circulating pump is approximately two hp., with average fan speed of 650 revolutions per minute. Heavy-duty self-aligning ball bearings are used throughout. All parts are of standard design and are readily available in all oil-field supply stores.



The unit can be changed to run in a counter-clockwise direction at a small additional cost. The company maintains a transportation department for field delivery direct from the factory.



The "STANDARD" 6-Feeder pictured above is furnishing dependable lubrication, automatically, by the drop ... according to the setting ... to this engine which is furnishing the power to pump a group of wells from a central power station. Thus is oil by the drop protecting costly machinery which is producing oil by the thousands of barrels. For full details on "STANDARD" Lubricators, address American Lubricator Co., Dallas, Texas.

"STANDARD" LUBRICATORS

All-Purpose Sling

ANNOUNCEMENT of a new type of sling specially designed for miscellaneous loads in the oil fields has been made by the Macwhyte Company, Kenosha, Wisconsin. This Siler Sling has three basic improvements that make it adaptable for any type of choker or basket hitch, and an auxiliary grapple hook that comes with it as standard equipment picks up small loads like bushings, bits, rotary chain, chain guards, tongs, etc. Special time-saving advantages are claimed for the new sling in laying down drill pipe. Line does not have to be fouled. The Siler Sling attaches easily and grips tightly. It is made of ⅜-in. Preformed Monarch Whyte Strand Wire Rope, with one sliding hook and one stationary hook, and is safe for loads up to 7000 lb., it is stated. Rope can be replaced in ten minutes without hot socketing.

Releasing and Circulating Overshot

THE American Iron and Machine Works Company of Oklahoma City, Oklahoma, and Houston, Texas, announces the manufacture of a new and improved releasing and circulating overshot, double-bowl type. By using the American double-bowl type overshot, the manufacturers say that operators have a fishing tool available at all times whether fishing for twisted-off drill pipe or tool joint.

With an American double-bowl type overshot on hand the drill stem can be run into the hole immediately, thus preventing the fish from freezing or falling into a cavity, it is stated.

In case operators have the regular-type American overshot it is possible to have it converted into a double-bowl type overshot by ordering extra slips and the necessary integral parts, the manufacturers advise.

Electrode for Flat Welding of Deep-Groove Joints

A NEW arc-welding electrode, which has been developed especially for flat welding of deep-groove joints in mild steel and which is said to provide welds of new high quality in this type of work, is announced by The Lincoln Electric Company, Cleveland, Ohio.

The new electrode, known as "Fleetweld 9," has been designed for use of industrial concerns engaged in the manufacture of products such as tanks, pressure vessels, etc., utilizing heavy-plate construction and requiring production of highest quality butt welds at maximum economy. The electrode provides weld deposits possessing high physical properties. Proper procedure with the electrode overcomes certain conditions frequently encountered in deep-groove welding that tend to cause the formation of surface holes in the metal. At the same time, the electrode has operating characteristics that assure uniformly economical performance, the manufacturers state.

All weld metal specimens of "Fleetweld 9" will have tensile properties as follows, varying somewhat with the composition of the plate, the heat of welding, capacity of the plate, and the size of the electrode used: the metal, as welded, tensile strength 66,000 to 74,000 lb. per sq. in.; yield point, $50,000 to 60,000 lb. per sq. in.; ductility elongation in two in., 20 to 30 percent. Stress relieved at 1200 deg. fahr., "Fleetweld 9" weld metal properties are: tensile strength, 64,000 to 72,000 lb. per sq. in.; yield point, 45,000 to 55,000 lb. per sq. in.; and ductility elongation in two in., 25 to 40 percent. Average tensile properties of stress-relieved "Fleetweld 9" weld metal, taken from 1½-in. plate welded with ¼-in. using 340 amp. a-c. are: tensile strength, 68,000 lb. per sq. in.; yield point, 53,000 lb. per sq. in.; ductility elongation in two in., 33 percent. On free bend test a specimen of the metal showed 78 percent elongation in outer fibers. Other physical properties of "Fleetweld 9" weld metal are: specific gravity, 7.85 to 7.86 grams per cc.; impact resistance, 30 to 60 ft-lb. (Izod), and endurance limit, 29,000 to 34,000 lb. per sq. inch.

"Fleetweld 9" is designed to operate with either alternating or direct current. The electrode is made in three sizes, 3/16 in., ¼ in., and 5/16 inch.

Enduring STRENGTH

A BEAR FOR WEAR

GRIZZLY Powerflex Rotary Hose has proved its enduring strength by drilling to completion many of the deepest wells in the toughest fields in the world. Its heavy armored construction, combined with its unusual flexibility, enables it to withstand constant pounding under terrific pressure. Ask the men in the field who use it.

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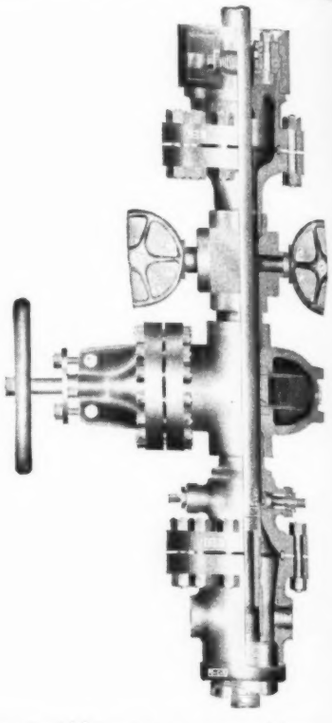
600-650 South Clarence Street . . . Los Angeles, California, U. S. A.
Complete Stocks Maintained In Our Warehouses At: 2311 West Street, Houston, Texas. 1008 S.E. 29th Street, Oklahoma City, Oklahoma. Sold in the Mid-Continent and Gulf Coast by: Continental Supply Co., and T. T. Word Supply Co., Inc., Houston, Texas — In All Their Stores.
Export Office: Continental Emsco Co., 30 Rockefeller Plaza, New York City.

"H-6" O-C-T Tubinghead

Oil Center Tool Company, Houston, Texas, has placed on the market a type "H-6" retractable seat tubinghead hook-up that permits washing behind liner before packer is set. The tubinghead body screws on the oil string before the plug is drilled, and the plug is drilled through blowout preventer equipment installed on the tubinghead body. After drilling the plug, the blowout preventer equipment is removed and a joint or two of tubing, with liner and packer installed below, is lowered in the hole. Then, the top assembly of the Christmas-tree is stripped over the tubing and connected to the main body of the tubing head. An O-C-T blowout preventer, equipped with a stripper rubber and installed above the tree, permits running the tubing string to bottom in perfect safety, the makers state, the stripper rubber passing tubing collars and serving as a stuffing box while washing behind the liner. The tubing hanger, which also passes through the stripper rubber, is made up in the tubing string at the desired point. The retractable seats provided in the tubinghead bonnet are screwed out to permit the hanger to pass while lowering the tubing string to wash behind the liner and collapse the packer. Following this operation, tubing is then raised to the suspending point and the



retractable seats are screwed in to engage the tubing hanger. The landing joint of tubing is then backed out and raised above the master gate valve, which is then closed, and the blowout preventer removed. A bull plug and pressure gauge are installed to complete the tree.

The type "H-6" O-C-T tubing head, shown in the accompanying illustration with a threaded connection on top of the bonnet, also is available to accommodate flanged gate valves.

According to the manufacturers, this tubinghead hook-up permits the use of regular tubing throughout—no flush-joint tubing being required to complete the well.

WHEN YOU AGAIN THREAD 2½- TO 4-INCH PIPE..

—investigate the "TOLEDO" No. 2BR Geared Adjustable Ratchet Threader.

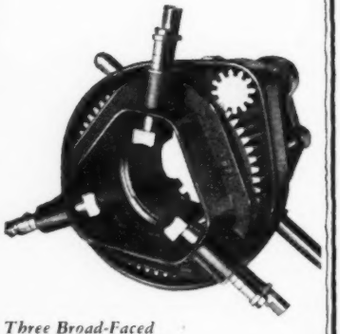
Separate set of dies for each size assures accurate, smooth, standard taper threads and easy cutting. No bushings are used. Three broad-faced chuck jaws operated by heavy set screws with size-marked guide bars make it easy to center tool on pipe. A strong, sturdy, compact 2½" to 4" threading tool that one man can operate easily anywhere.

Sold by leading Oil Well Supply Dealers.

THE TOLEDO
PIPE THREADING
MACHINE CO.

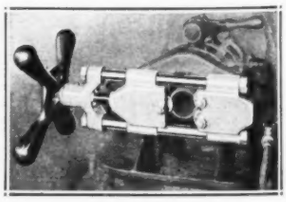
TOLEDO, OHIO

NEW YORK OFFICE
72 LAFAYETTE ST.



Three Broad-Faced Chuck Jaws Make for Easy, Accurate Centering

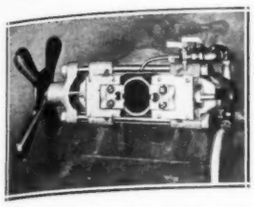
Improvement to Pipe Threading and Cutting Machine



Wheel Cutoff

SINCE its introduction in 1931 the Beaver Model-A portable unit for cutting and threading pipe and bolts has popularized many important me-

chanical features as applied to small portable pipe machines, its makers, Beaver Pipe Tools, Inc., Warren, Ohio, state, such as: (1), rack-and-pinion



Knife Cutoff

feed; (2), quick-opening fully-adjustable dieheads; (3), full ⅛- to 2-in. range; (4), double-duty—that is, solid round bars may be cut and threaded as well as pipe; (5), right-hand operation—like a standard lathe or other machine tool. Now the company announces another engineering advancement: the choice of wheel-and-roller cutoff or automatic-knife cutoff. The devices are interchangeable.

Regulator for Firing Oil-Field Boilers

ANNOUNCEMENT is made by Natural Gas Equipment, Inc., of Los Angeles, California, of a new regulator for automatically firing oil-field boilers. This regulator is designed to meet the need for closer control of steam pressure on drilling boilers and

to provide for the accurate regulation of the maximum and minimum gas pressure on the burner. The Boilertrol, the name of this new regulator, is a combined steam control regulator and reducing valve.

The greatest advantage of the Boilertrol, according to the makers, is that one regulator serves the purpose of both gas-fuel regulator and reducing regulator for oil-field boiler plants. Fuel supply pressure changes are automatically compensated for and have no effect on the operation of the regulator or the boilers.

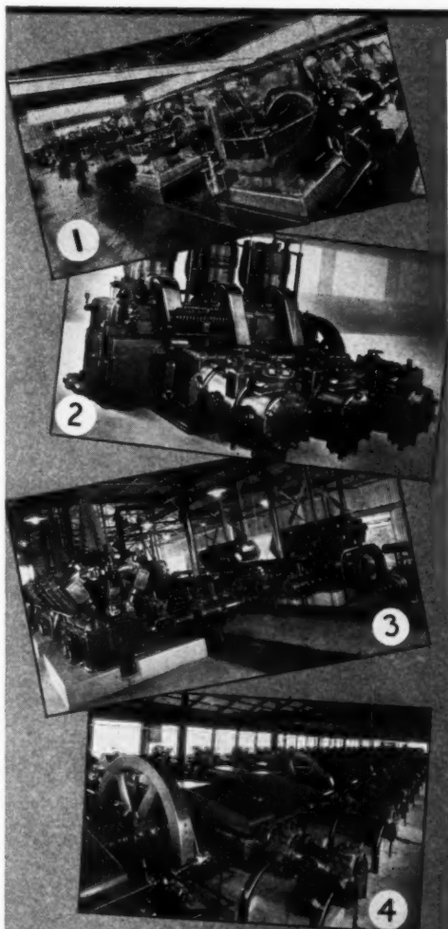
The N. G. E. Boilertrol is truly two valves in one. It acts as a reducing valve at all times in addition to varying gas-burner pressure in accordance with steam demands upon the boiler.

The Boilertrol is pilot operated and will maintain steam pressure within three lb. under extreme changes in load. The regulator is of the pressure-loaded type and will not surge, pulsate, or override.

The Boilertrol has such a wide range of adjustment that spring changes are never necessary for any oil-field boiler plant. There are only two adjustments that can be made: (a) The steam pressure setting, readily adjusted by turning the hexagon adjusting nut with any common monkey wrench or end wrench; (b) The maximum burner pressure adjustment that readily can be made with any screwdriver.

Further information may be obtained from the manufacturer, Natural Gas Equipment, Inc., 541 Petroleum Securities Bldg., Los Angeles, California.

Seal your reciprocating piston rods
the way so many engine and compressor builders do . . . with
COOK'S METALLIC PACKINGS

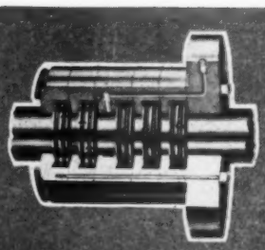


1-COOPER-BESSEMER CORP.
2-CLARK BROTHERS COMPANY
3-INGERSOLL-RAND COMPANY
4-WORTHINGTON P&M CORP.

Any engine or compressor is a more efficient unit if its rods are fitted with COOK'S METALLIC PACKING. The leading engine builders recognize this fact. Noteworthy applications are represented by the equipment, shown in the accompanying illustrations, that comes factory-equipped with COOK'S PACKINGS.

There is an approved type for all pressures fitted with packing rings made of COOK'S GRAPHITIC IRON, Cookmet, Babbitt or Micarta, as the requirements of service suggest.

For existing equipment, communicate with us direct or our nearest branch office.



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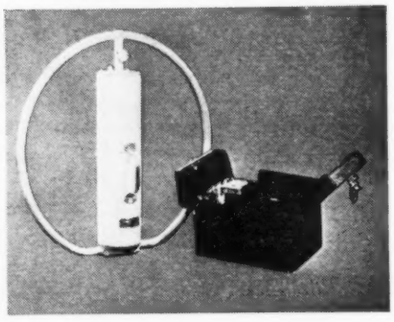
Radio Equipment for Locating Pipe Lines

ENGINEERING Laboratories, Inc., Tulsa, Oklahoma, specializing in the manufacture of Seismic equipment and special electrical, radio, and mechanical engineering, affiliated with Seismograph Service Corporation, announces a new pipe-line radio especially designed for an unskilled person to operate. Used to indentify quickly the line under ground and follow it out, the makers claim it to be a method by which an individual line can be followed without confusion, despite close proximity to parallel lines, crossings, etc. Laterals are indentified by the presence of a distinct signal taking off to one side of the main line and swedges are indentified by sudden decrease in signal strength when the pipe line decreases. By holding the receiver by the handle, in a horizontal position close to the ground and moving back and forth over the probable location, the signal will completely disappear when the receiver is directly over the pipe. The instruments come complete with cases, two spears, and leads for connecting transmitter to line, batteries, and head phones.



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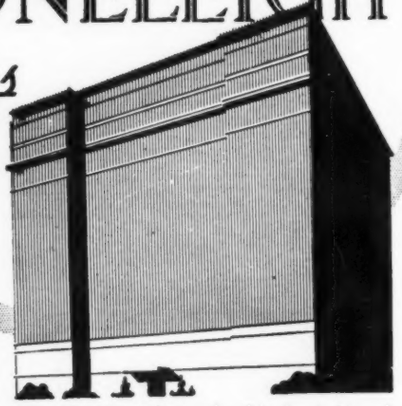
in the quiet atmosphere
of the South's finest Hotel
The STONELEIGH
Dallas
Maple Ave. at Wolf St.

Rates from $3.00



Come to the
GREATER TEXAS PAN AMERICAN EXPOSITION
Dallas

The Stoneleigh is the kind of Hotel that will increase immeasurably the enjoyment of your visit to Dallas. Located in the quiet residential district overlooking the city, the Stoneleigh offers comfort and luxury that is not extravagance in any sense. For service, food and accommodations here are always well within reason. Whether you come to Dallas on business or pleasure, your stay at the Stoneleigh will be an unforgettable experience.

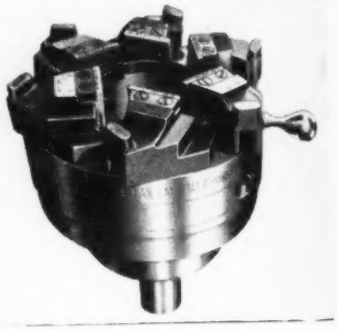
DON E STEWART MANAGER

Landis 40 AX Die Head

THE Landis Machine Company of Waynesboro, Pennsylvania, has added to their line of threading equipment a new die head for threading large diameters, long thread lengths.

The diametrical capacity of the head is 4 in. to 5⅛ in., with a pitch range of 7 to 20 threads per inch. Thread length, while not unlimited, is sufficient to take in an exceptional range. The head illustrated has a capacity of 7-in. thread length on 5⅛-in. diameter.

The new die head belongs to the Landmatic series and is of the self-opening, pull-off type for application



to turret lathes and to hand-screw machines. It is heat-treated throughout and ground for maximum wearing qualities. Diametrical graduations on the circumferential surface and micrometer graduations on the adjusting screw insure rapid and accurate size changes.

The 40 AX Landmatic head carries six chasers mounted on the face of the head similar to the four-chaser die head. By using six chasers instead of four, the cutting load is more widely distributed. Thus the working parts of the head, as well as the part being threaded are subject to much less cutting stress. The results, according to the makers, are an increase in tool life with more threads obtained per grind of the chaser, improved quality of the product being threaded, and also an increase in the life of the die head.

NEED CLEANING TOO!

Sand and sediment is holding back your oil—clean it out quickly with the MILLER Sand Pump and get more oil at small cost.

The MILLER is made in diameters of 2½, 3, 3½, 4, 4¼, 5, 5½, 7 and 9 inches and lengths of 20, 25 and 30 feet. 5/32-inch wall thickness in REGULAR Type, ¼-inch wall tubes HEAVY Type Sand Pumps.

INTERCHANGEABLE BOTTOMS
To Meet Every Condition

- BAILER BOTTOM
  With the Bailer Bottom installed the MILLER is quickly changed to a Bailer giving you a combination of either Bailer or a Sand Pump in one tool.
- SAND BOTTOM
  Used when tools are run and when well is shot to quickly remove loose material.
- STAR BOTTOM
  Used for cutting the sand loose.
- CHISEL BOTTOM
  (In Pump)
  With this bottom tightly packed sand can be easily broken in small pieces so it can be picked up in the pump.

Write for Descriptive Folder and Price List

See Page 1186 COMPOSITE CATALOG

PATENTED
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MILLER Sand Pump Co.

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OKLAHOMA CITY, OKLA., U. S. A.

Branch Shops and Offices:
SAPULPA, OKLA. and KILGORE, TEX.

FOR SALE BY SUPPLY STORES EVERYWHERE

Flamenol Cable Introduced

A NEW synthetic insulating compound has been introduced commercially by the General Electric Company under the trade name Flamenol. While similar to rubber in its characteristics, it contains no rubber and will not support combustion.

Termed the most marked cable development in the last 25 years, Flamenol is said to be entirely different from any insulation previously available. In addition to being non-combustible it is highly resistant to moisture, acids, alkalies, and oils. It has excellent aging characteristics and is strong mechanically, the makers state.

The properties of Flamenol are such that it can be made a very soft and flexible compound, or made to be one with celluloid-like rigidity. It can be put into solution for coating or impregnating, and can be compounded, filled, calendered, and extruded in much the same fashion as rubber.

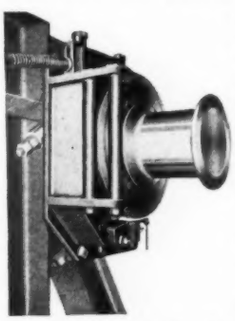
Flamenol-insulated cable is recommended for power and control circuits at 600 volts and less, and for operation at a maximum copper temperature of 60 deg. centigrade. It is well adapted to machine-tool wiring, switchboard wiring, and battery and coil leads, it is stated. Flamenol has a permanently smooth finish and foreign materials do not readily adhere to its surface. It is available in a variety of colors for circuit tracing. For most applications Flamenol is used without any protective finish, such as braid, lead, or armor.

Wilson 150-Amp. A-C. Transformer Arc Welder

A 150-amp. a-c. transformer type arc welder has been added to the extensive line of machines manufactured by the Wilson Welder and Metals Company, Inc., of 60 East 42nd Street, New York City. With the addition of the new model, there now are available a-c. arc welders in capacities of 150, 300, 500, 750, and 1000 amperes. All are complete and self-contained units and need no other accessories, except the welding cable, electrode holder, and hand-shield.

One of the several distinctive features incorporated in the machines includes a system of three controls or adjustments of the welding current. Through the medium of the first two controls it is possible to obtain 25 coarse adjustments. The third control offers a further and finer adjustment of current values within any one of the foregoing 25. By means of these three controls an infinite number of settings may be obtained.

IT takes "follow thru" to give a long smooth stroke packed with power — and that's exactly what you get in the MacClatchie Gearomatic Cathead! Geared 2 to 1, this cathead has *double* the power at *half* the line shaft speed, giving tremendous force to smoothly break the largest, most stubborn tool joints without jerks and *without impact strains on rig equipment.*



And remember—this ruggedly built cathead has no clutches to jam or get out of adjustment. A positive kick-out device allows one revolution—and *one only*—per pull, positively eliminating fouled lines and assuring definite safety for crew and equipment.

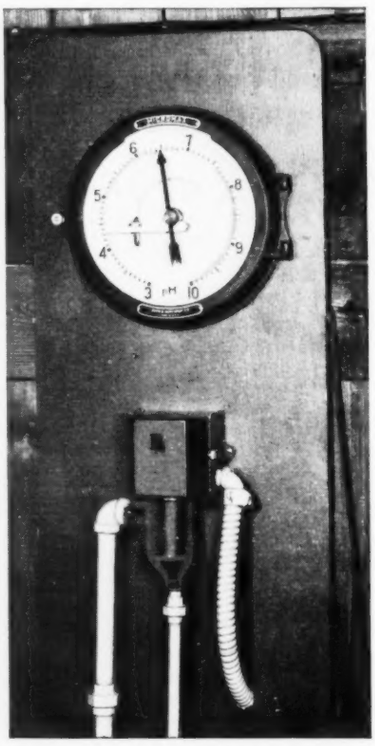
Get in touch with your nearest MacClatchie representative today. He will gladly explain the time and money saving features of this modern cathead.

MACCLATCHIE MANUFACTURING CO.
Compton, Calif. Houston, Texas
Export:
Geo. R. Woods, 17 Battery Pl., New York

Equipment for Improving Corrective Water Treatment

REFINERY operators now follow the alkalinity of dehydrator water from gasoline scrubbing towers simply by glancing at a bold dial on which a big black pointer continuously indicates pH. Or they see what the pH trend has been in the past simply by examining an automatically-drawn red-ink record.

To make possible this convenient guide, a compact electrode assembly automatically detects the pH of a continuously flowing sample of tower water . . . and a standard Micromax recorder, placed wherever desired, regardless of distance from the tower, automatically indicates and records it. Said to be unusually rugged, both electrode assembly and recorder operate reliably with only a reasonable amount



of maintenance and are easy to install, its makers state.

Not only is this equipment being used in oil refineries, but in water purification plants, in many power plants (for regulating treatment of boiler-feed water), and by many manufacturers of food products, beverages, ice, chemicals, textiles, textile products, etc. In addition to indicating and recording pH, it also can be equipped to control automatically.

A 20-page illustrated bulletin, "To Improve Corrective Water Treatment," describes many of the features of this equipment. Anyone interested may have a copy simply by writing to Leeds & Northrup Company, 4934 Stenton Avenue, Philadelphia, Pennsylvania.

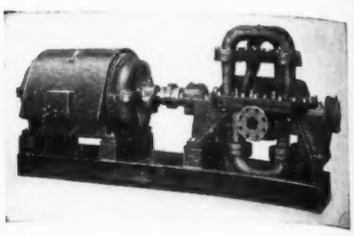
Improved High-Pressure Centrifugal Boiler-Feed Pumps

A NEW LINE of multi-stage centrifugal boiler feed pumps, for pressures to 1200 lb. per sq. in., is announced by Worthington Pump and Machinery Corporation, Harrison, New Jersey.

Axial hydraulic balance and equalized radial thrusts are claimed by the manufacturer to make these pumps among the most perfectly balanced on the market today. An even number of impellers, facing in opposite directions, serve to equalize the axial forces and eliminate balancing drums or discs. In addition, large thrust bearings insure long life and reduce maintenance costs.

The staggered volute construction effects radial hydraulic balance, reducing wear on internal clearances, and eliminating stuffing box troubles.

Other physical improvements are exceptional accessibility, an external



inter-stage loop, a casing shaped to prevent erosion and eddy currents, and heavy-duty oil-lubricated ball bearings mounted in dirt-proof housings. The horizontally-split casing, with suction and discharge nozzles in the lower half, permits the pump to be taken apart readily for inspection or repair.

The pumps are made in 4-in, 6-in. and 8-in. sizes for a speed range from 2500 to 4000 revolutions per minute. Capacities range from 200 to 1500 gal. per min. and pressures up to 1200 pounds.

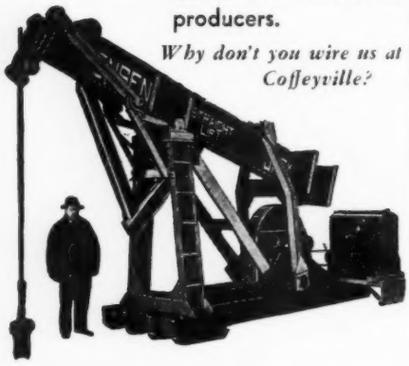
Full details may be obtained by requesting bulletin W-318-B7A from the manufacturer.

TO
OPEN
MINDED
PRODUCERS

"You'll have to show me" is music in our ears when spoken by a producer who has wells to pump. We don't want his money unless we can show him how to lift oil more economically and efficiently than by any other method.

For JENSEN Straight-Lift PUMPING UNITS and ROD LINE JACKS climax nineteen years of experience on the part of ourselves and successful producers.

Why don't you wire us at Coffeyville?



JENSEN
BROTHERS
MANUFACTURING CO.
. . . *Coffeyville, Kansas*

STRAIGHT TALK.... *about* CROOKED HOLES

Write for literature

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425 Petroleum Building, Tulsa, Okla.
3118 Blodgett Avenue, Houston, Texas
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Bank of Lafayette Bldg., Lafayette, La.
c/o Elks Club, 17th and I Streets, Bakersfield, Calif.

THE CLEVELAND—"MODEL 110"

SIMPLIFIES YOUR DITCHING PROBLEMS

Digs "Anywhere...Anytime"

"Clevelands" are simple in construction—simple to handle on the job and simple to transport.

Yet, they are extremely versatile, with many exclusive features which enable you to get more work done under everchanging job requirements.

This is accomplished through "Clevelands" quality design and construction, which, while extremely modern has **come through, on the job,** with flying colors, under practically every condition such a machine is likely to encounter.

If you want to simplify your ditching problems and effect substantial money savings, put one of these practical machines to work on your next job. Meanwhile, let us send you more complete details.

THE CLEVELAND TRENCHER COMPANY

"Pioneer of the Small Tractor"

20100 St. Clair Avenue **Cleveland, Ohio**

An important "Cleveland" idea that simplifies transportation and increases versatility. High-speed, low-cost transportation via special trailer. "Clevelands" load or unload on their own trailers in 10 to 15 minutes. Move from place to place at truck speed.

CLEVELANDS

NOW IS THE TIME *to double check your cleaning*

NOW, when you are scrutinizing the year's developments in new, better methods and machinery ...don't forget your cleaning! Here, for instance, are a few jobs where Oakite materials and methods provide the quickest, most thorough cleaning results.

Absorbers	Tank Cars
Oil Drums	Service Stations
Oil Coolers	Trucks
Salvaged Parts	Paint Removal

Write to have our Service Man call to talk over these important operations. Get the helpful ideas he can offer. No obligation.

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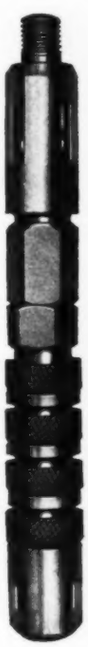
SPECIALIZED INDUSTRIAL CLEANING MATERIALS & METHODS



One way to AVOID TROUBLE

You can't afford to take chances with working-barrel valves. It pays to SPECIFY HOUGH—the Valves that have proved to be FIRST in dependability. (Illustrated is the Hough Protex Upper Valve—a real safety unit.) The Charles N. Hough Mfg. Company, Franklin, Pa., and Tulsa, Okla.

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Working Barrel Valves

ENSIGN

Combination

GAS & GASOLINE CARBURETOR

This widely used Ensign (Type K g n l) Carburetor permits the use of either gas or gasoline for fuel in practically any type of multiple cylinder engine. Combining all the exclusive features of Ensign gas and gasoline carburetors, it assures maximum power delivery with minimum consumption of either fuel. Write for detailed information and prices.

ENSIGN CARBURETOR CO., Ltd.
Huntington Park ◆ California
Branches: Chicago, Illinois; Dallas, Texas

100 Pounds or More Cut to Medium or Low Pressure

Fulton Toggled Reducing Regulator

GAS pressures of 50 to 100 pounds or more in tanks or transmission lines are reduced to medium or low pressure in the distribution system by the Fulton Toggled Reducing Regulator. It can be equipped to operate with either natural or manufactured gas, maintaining the desired delivery pressure. Constructed with oversize valves for industrial furnace installations. Also adapted to control of By-Product Coke Oven Gas. Ask for Bulletin No. 2573.

THE CHAPLIN-FULTON MFG. CO.
28-40 Penn Avenue Pittsburgh, Pa.

Rieber's Houston Offices in Esperson Building

FRANK RIEBER

Frank Rieber, head of Rieber Laboratories, Los Angeles, announces the recent opening of new offices in Houston, Texas, at 1002-3 Esperson Building. The Houston Division is in charge of E. M. Lane, who has been a member of the Rieber organization for the last ten years. William H. Gayman and Neville C. Hunsaker are attached to the Houston office as geophysicists and Olai I. Torkelsen as geologist. Rieber recently returned from a tour of inspection of the field work now being conducted with the Sonograph by the Houston Division.

Gulf Coast and Mid-Continent operators are invited to visit the new offices and to inspect the geophysical equipment and methods employed by the Sonograph system.

E. M. LANE

President Authorized to Invite to Houston Show

As a result of a resolution passed by Congress, introduced by Congressman Albert Thomas of Texas, the President of the United States has been authorized and is inviting all the states of the union and all foreign countries to participate in the Oil-World Exposition at Houston, Texas, October 11 to 16, inclusive.

Invitations have been sent to Vice-President John Garner and to Jesse H. Jones, chairman of the R.F.C., to act as officials at the opening of the new Jesse H. Jones Coliseum and the Oil-World Exposition, which will be held on October 11 at 1:30 P. M.

The resolution, providing for invitations to the states and foreign countries for the Houston Show, states: "The President of the United States is authorized to invite by proclamation, or in such other manner as he may deem proper, the states of the union and all foreign countries to participate in the proposed Oil-World Exposition, to be held at Houston, Texas, from October 11 to 16, 1937, inclusive, for the pur-

pose of exhibiting samples of fabricated and raw products of all countries used in the petroleum industry and bringing together buyers and sellers for promotion of trade and commerce in such products.

"All articles that shall be imported from foreign countries for the sole purpose of exhibition at the Oil-World Exposition upon which there shall be a tariff or customs duty shall be admitted free of the payment of duty, customs, or charges, under such regulations as the Secretary of the Treasury shall prescribe; but it shall be lawful at any time during the exhibition to sell any goods or property imported for and actually on exhibition, subject to such regulations for the security of the revenue and for the collection of import duties as the Secretary of the Treasury may prescribe: Provided, that all such articles when sold or withdrawn for consumption or use in the United States shall be subject to the duty, if any, imposed upon such articles by the revenue laws in force at the date of withdrawal; and on such articles which shall have suffered diminution or deterioration from incidental handling and necessary exposure, the duty, if paid, shall be assessed according to the appraised value at the time of withdrawal for consumption or use, and the penalties prescribed by law shall be enforced against any person guilty of any illegal sale, use or withdrawal.

"The government of the United States is not by this resolution obligated to any expense in connection with the holding of such exposition."

No Increase in Hotel Rates

All hotels in Houston have agreed to maintain standard prices charged throughout the year during the exposition.

The Houston Chamber of Commerce has appointed a Housing Committee, which has listed all the smaller hotels with their rates, facilities, and standing. This committee also has listed several hundred rooms in private residences where visitors also may obtain accommodations.

Single rooms in Houston hotels may be obtained from $2.50 per day up; double room from $4.00 per day up. Reservations can be made through the Oil-World Exposition, Inc., Petroleum Building, Houston, Texas.

Parkersburg Rig and Reel Co. Announces Changes in Sales Set-Up

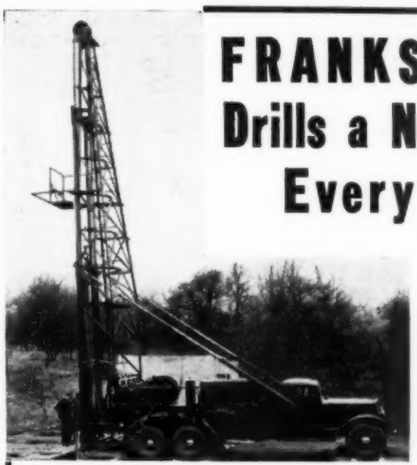
Several important changes in the sales set-up of The Parkersburg Rig & Reel Company have been announced.

The office of the sales manager, effective July 1st, was moved from Parkersburg, West Virginia, to Dallas, Texas. P. L. Brooks, present sales manager, also will be located in Dallas in charge of the new offices. This move is expected to add materially to the effectiveness of the Parkersburg sales force and result in improved service to operators in the Mid-Continent, Texas, Gulf Coast, and California fields. H. D. Crawford, assistant sales manager, remains in the home office and will have charge of Eastern sales.

S. P. Wallace, who has been stationed in Dallas in charge of the Tri-State District, has been moved to the home office in Parkersburg, West Virginia, and named assistant general manager.

E. L. Byer, assistant manager in the Oklahoma and Kansas District, has been transferred from Tulsa to Dallas to take over the position vacated by S. P. Wallace.

Charles Ferguson has been transferred from his position as branch manager in Oklahoma City and made city salesman in Tulsa. Ferguson's former position will be filled by K. H. Kanalz, who has been working as field engineer in the Oklahoma and Kansas District.



FRANKS UNIT Drills a New Well Every Day

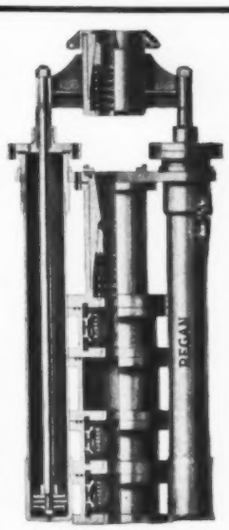
Franks Model 3000 Unit

Franks combination Portable Rotary and Core Drill with Hydraulic feed is made in four models for exploration drilling; coring up to 4,000 ft.; production drilling up to 3,500 ft.; drilling input water wells, etc.

A Franks Model 2000 Portable Rotary drilled a 750-foot well at a cost of 28 cents per foot and was moved to another location all within a 24-hour period. This record was sustained on a number of wells in Kansas. Write for Franks Catalog on this unit.

FRANKS MFG. CORP.
WELL SERVICING AND DRILLING UNITS
P. O. Box 137 Whittier Station Tulsa, Okla.
Export Office: 149 Broadway, New York

REGAN
COMBINATION GAS CONTROLLER and SNUBBER



This unit allows operator to move tubing in or out of well at will and under pressures requiring snubbing means to control the tubing against any movement opposite the desired direction. Rubber sleeves tightly grip the tubing when the well pressure is admitted through the manifold valves to the chambers in which they are housed. This is companion equipment for Regan GC Tubing Head.

Bulletin describing this Combination Gas Controller and Snubber and companion equipment is available. Also refer to Composite Catalog.

Regan Forge & Engineering Co.
Plant and General Offices San Pedro, Cal. P. O. Box 150
Mid-Continent Office—1502 Maury Street, Houston.
Oklahoma—Mid-Co Tool & Supply Co., Oklahoma City.
Kansas Representative—Bovaird Supply Co., Wichita.
New York City Office—17 Battery. G. R. Woods, Mgr.

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Collins Belt Clamp

is based on an

Entirely New Principle

- Bolts don't break
- No bending stress in the bolts
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- Important time and money saving

The COLLINS *Belt Clamp is founded on a principle that is entirely new in Belt Clamp construction . . . The illustration shows clearly why its operation is ideal.*

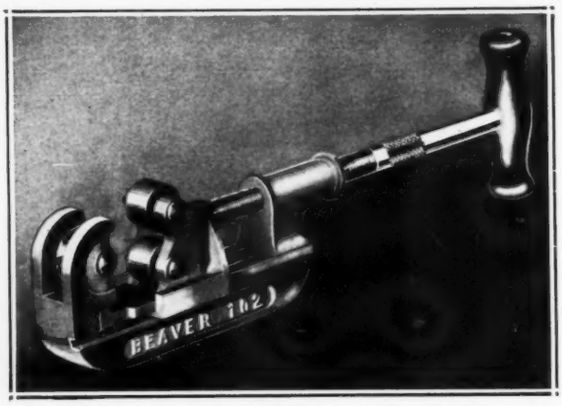
Where Obtainable?

Principal B-M-W Products are sold at supply stores, including . . . ● ADMORE Insert Pump Anchors; ● NEILSON TOOLS (Safety Sucker Rod Hooks, Tubing Hooks, Rod Elevators, Sucker Rod Sockets, etc.); ● BALLS and SEATS (made for every pumping service); ● ADMORE Liner Barrels; ● TEX TYPE Plunger Fittings and Valves; and ● COLLINS Belt Clamps.

BRADFORD MOTOR WORKS INC.

OIL WELL SUPPLIES

BRADFORD, PA. — TULSA - OKLA.



It's Built "Square"

and Guaranteed to Track!

Patented surface-ground construction. All parts at exact right angles to each other—therefore guaranteed to track. Made of MALLEABLE iron — to withstand severe abuse. Three types of wheels available (1) standard pipe, (2) cast iron pipe, (3) thin wall tubing. Wheels and rollers are standard and interchangeable with other tools.

No. 102—⅛ to 2" one wheel cutter $3.30; 3-wheel $3.60. No. 204—2½ to 4" 3-wheel only $10.00. Buy through your jobber.

BEAVER PIPE TOOLS

737 PETROL AVE. WARREN, OHIO

Paul Kelting, Houston Representative E. M. Smith Co.

The E. M. Smith Company of Los Angeles, California, manufacturers of the Grizzly line of industrial products, announces the appointment of Paul Kelting as its factory representative with headquarters at the company's newly-opened warehouse at 2311 West Street, Houston, Texas. Kelting, who has been active in both the Mid-Continent and Gulf Coast oil fields since 1920, for the past ten years has been connected with the Emsco Derrick and Equipment Company as manager of derrick sales, Southern Division, with headquarters at Houston, Texas.

PAUL KELTING

The new factory branch of E. M. Smith Company will maintain a Grizzly rotary brake band exchange. Under this exchange plan genuine Grizzly full-moulded rotary brake blocks installed on new steel bands that are exact duplicates of those used on the drawworks by the manufacturer, are exchanged for the old, worn, and warped bands that are junked.

In addition to the brake band exchange the company will carry a complete stock of Grizzly powerflex rotary hose, Grizzly drill pipe protectors, Grizzly "No-Wip" wire line savers, X-T woven brake blocks, Grizzly raw-edge and other types of belting, and mechanical rubber goods.

Ensign Carburetor Company to Open Dallas Branch

Gilbert Woodill, sales manager, Ensign Carburetor Company, Ltd., Huntington Park, California, announces completion of arrangements for the opening of a branch at Dallas, Texas; where the company will maintain complete stocks of all sizes of Ensign equipment for distribution to sales and service representatives, as well as to users in the various Texas, Mid-Continent, and Gulf Coast oil fields. He will leave shortly for Dallas to personally supervise the opening of this branch, which he plans to have ready for business early in August.

L. C. Arter

In many respects this branch will be similar to the one opened by the Ensign company in Chicago last year. Ensign carburetors and fuel-regulating equipment will be shipped from the factory to its newest branch in semi-assembled condition.

L. C. Arter, who has had wide experience in the Texas and Gulf Coast territory, as well as eastern and mid-western states, will be in charge of the Dallas branch. He has been with the Ensign Carburetor Company for 15 years.

E. J. Daly Joins Staff Wickwire Spencer Steel Co.

E. J. DALY

E. J. (Jack) Daly, who has been with the Regan Forge and Engineering Company, resigned, effective July 1st, to join the staff of the Wickwire Spencer Steel Company. He will represent that company in the Texas Gulf Coast and Louisiana fields, making his headquarters in Houston, Texas.

Daly returned to the United States a year and a half ago after having spent a number of years in the oil fields of Upper Burma with the Burmah Oil Company.

Billings and Spencer Co. Hold Sales Conference

The sales organization of The Billings and Spencer Company of Hartford, Connecticut, held a three-day sales conference recently, at which time Billings representatives from all over the United States and Canada were present.

As the sessions progressed, the chief interest of the salesmen was focused on the following: new equipment, the

means taken to assure close limits on all work; the departmental inspection, the final inspection, the physical tests to which each lot of wrenches is subjected before reaching the inspection department; the engineering department in which plans are formulated for the merchandise and die-design changes to improve the products; the metallurgical department, and the methods employed in solving metallurgical problems such as special materials; and finally the laboratory in which the physical properties of the finished products and the chemical properties of all materials are determined and tested. The sales organization especially was interested in tests conducted on various types of tools in which tests the torque and tensile values of the finished products were automatically registered.

Buckeye

Service Ditcher

. . . . JUST RIGHT

MODEL 12

for DITCH 15" to 24" WIDE

Some ditching looks easy — until you start. Or it may look plenty tough. But whether stony soil, restricted right of way, heavy time penalties in the contract, exactness required, or any of a dozen other difficulties confront you, a Buckeye Model 12 will see the job through on schedule.

It digs trench 15" to 24" wide to 5½' deep, at speeds ranging from 22" to 156" per minute. An additional sprocket gives 28' per minute. No soil short of solid rock can stop it. Complete facts are yours for the asking.

BID THE Buckeye WAY
ask for our operation data before you bid

THE BUCKEYE TRACTION DITCHER CO.
FINDLAY, OHIO, U. S. A.

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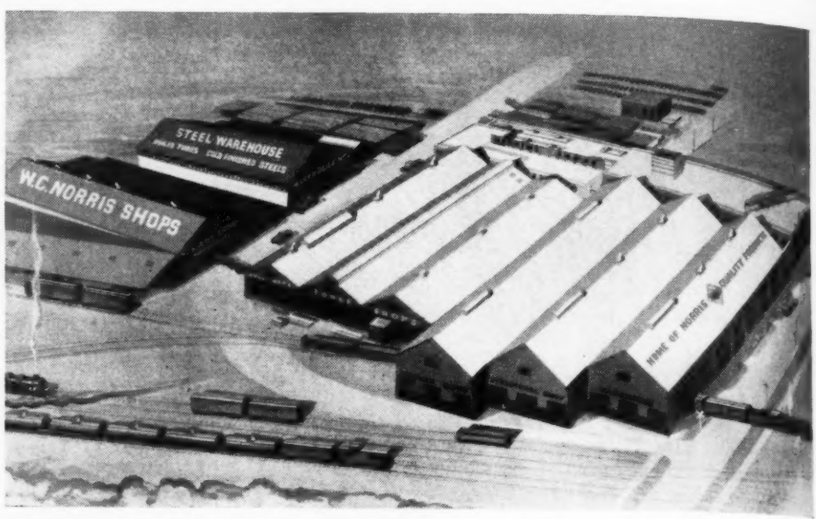
Manufacturing Buildings of W. C. Norris Manufacturer, Inc., Tulsa, Oklahoma

REPRODUCED herewith is the latest view of the manufacturing buildings at Tulsa, Oklahoma, of W. C. Norris Manufacturer, Inc. Twice enlarged within a short time, this plant represents the very latest in manufacturing facilities for oil well surface equipment, from sucker rods, pull rods, and working barrels, to the well-known Norris OK jacks and special type swings, hold-downs, and hold-ups.

From modern air-conditioned offices to the new structural steel warehouse, assembly plant for structural work, new sucker rod manufacturing plant, and greatly enlarged machine shops, the plant is a visual expression of the 56 year manufacturing career of its founder, W. C. Norris. Widely known in supply circles and throughout the industry generally Don Bowers is vice-president and general manager, with Joe Eustice as sales manager, and Gene Forquer secretary-treasurer.

The company maintains distributing facilities and stocks at Houston, Big Spring, and Kilgore, Texas, with special sales representatives in all active Mid-Continent fields. Export shipments are handled through New York representatives.



Maintenance Engineering Formally Opens New Plant

MAINTENANCE Engineering Corporation, Houston, Texas, formally opened the new Meco plant at 3611 Clinton Drive June 28th by being host to the Houston Purchasing Agents Association. Including some friends of association members approximately 130 men were served lunch, following which a tour of inspection was made through the plant. C. E. Naylor, chairman of the board of directors, and Joe Peddie, president of the Maintenance organization, welcomed the guests in brief talks, and O. D. Story, president of the association, thanked the Meco staff for an excellent reception on behalf of the association.

The recent move to new, enlarged quarters coincidentally celebrates the 13th anniversary of Maintenance Engineering Corporation. This company's position today as factory representative for numerous leading manufacturers of oil industry equipment throughout the nation, with a staff of 45 men, and occupying 60,000 sq. ft. of plant space on a 2½-acre site, is a far cry from its beginning in 1924 when C. E. Naylor directed all business from one rented room with a single assistant.

The new Meco plant is equipped with welding and shop facilities for fabricating special hook-ups to oil company specifications and has a most modern water-testing laboratory.

Trade Personals

C. W. GILMER, manager mechanical sales, Seattle, Washington, branch of the Mechanical Goods Division of United States Rubber Products, Inc., has been transferred to the New York office as belting sales engineer. L. F. KOEPP, formerly salesman in the Seattle district, has been appointed manager of mechanical sales to take Gilmer's place in the Seattle branch.

●

L. D. CAIN, sales manager of Portable Rig Company, Inc., Houston, Texas, was a recent visitor in Dallas, Texas, and Tulsa, Oklahoma.

●

BOB PEASE, manager of the St. Louis plant of the Axelson Manufacturing Company, and Mills Hammett, sales manager for Axelson in the Mid-Continent territory, flew to Los Angeles on July 7 to take part in a national sales and production conference being held at the Axelson plant.

●

H. F. BOE has been appointed commercial manager of the Westinghouse Electric and Manufacturing Company, it is announced by N. G. SYMONDS, vice-president. Boe will have two headquarters, one in the Union Bank Building at Pittsburgh, the other at 150 Broadway, New York.

●

H. B. ALLEN, who for 14 years was New York District sales manager of the Babcock and Wilcox Tube Company, has resigned from that company to become vice-president of John B. Astell and Company, Inc., 90 West Broadway, New York.

Changes in Personnel and Organization Set-Up of Eagle-Picher Lead

Several major changes in official personnel, as well as a decentralization plan, have been announced by Eagle-Picher Lead Company's board of directors. Most important of the changes in personnel is the resignation of A. E. Bendelari as president of the various Eagle-Picher companies. His successor will be Joseph T. Hummel, Jr., former secretary-treasurer.

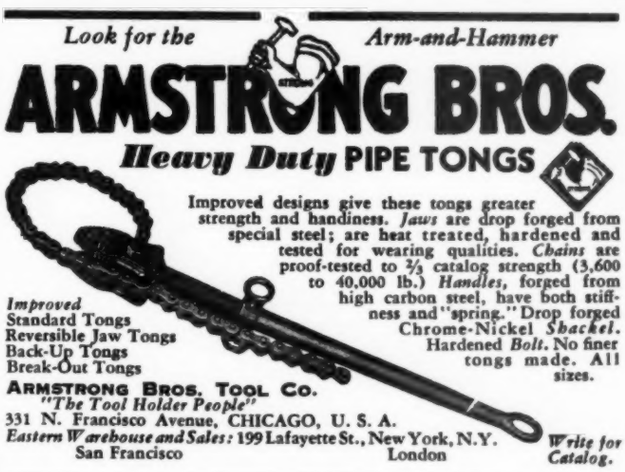
In tendering his resignation, Mr. Bendelari explained, "Although I will retire as president, I have consented to remain on the board of directors and to serve on the executive committee. I will also retain my directorship in the American Mining Congress, the American Zinc Institute, and the Lead Industries Association as a special representative of Eagle-Picher."

Simultaneously with the resignation of Bendelari and the election of Hummel as president and treasurer, the board of directors announced the election of William R. Dice as executive vice-president and Vincent H. Beckman as secretary.

The plan of decentralization follows an organizational plan somewhat similar to that recently adapted by such firms as General Motors and Westinghouse. The three divisions of the company—the White Lead in Oil Division, the Insulation and Metal Division, and the Pigment and Oxide Division—will now operate as three independent units, with sales and production coördinated under divisional general managers.

T. C. Carter becomes general manager of the Insulation and Metal Division, William H. Hayt has charge of the White Lead in Oil Division, and Miles M. Zoller assumes control of the Pigment and Oxide Division. The general office remains in Cincinnati.

Gotkool
WATER CANS & COOLERS
GOTT Water Coolers are the convenient way to keep drinking water handy to the worker, protect it from impurities. Their exclusive construction keeps water cool for long periods. Snug fitting large removable top, handy non-leaking push button faucet. GOTT Water Cans for handy field use. Your Supply Store has them, get one today!
Gott
WATER COOLER
GOTT WATER COOLER
Made in 3, 5, 8, 10, and 20 gallon sizes.
GOTT WATER CAN
H. P. GOTT MFG. CO.
WINFIELD, KANSAS
KEEP PURE DRINKING WATER ALWAYS HANDY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Arm-and-Hammer
ARMSTRONG BROS.
Heavy Duty PIPE TONGS
Improved designs give these tongs greater strength and handiness. Jaws are drop forged from special steel; are heat treated, hardened and tested for wearing qualities. Chains are proof-tested to ⅔ catalog strength (3,600 to 40,000 lb.) Handles, forged from high carbon steel, have both stiffness and "spring." Drop forged Chrome-Nickel Shackel. Hardened Bolt. No finer tongs made. All sizes.
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Standard Tongs
Reversible Jaw Tongs
Back-Up Tongs
Break-Out Tongs
ARMSTRONG BROS. TOOL CO.
"The Tool Holder People"
331 N. Francisco Avenue, CHICAGO, U. S. A.
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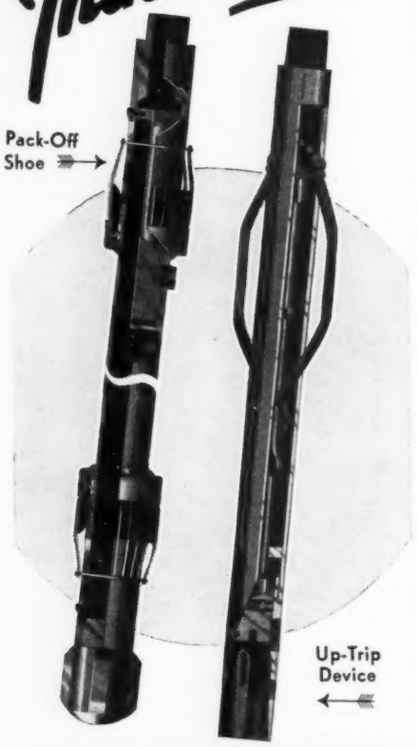

THE CAVINS *Perforation* WASHER

The Cavins Perforation Washer is a combination of the Up-Trip Device and Pack-Off Shoe, shown above, with The Cavins Automatic Hydraulic Suction Bailer.

This tool is without a parallel for cleaning perforated oil strings, liners and screens. It utilizes the natural forces present in the well to effectively remove sand, mud, shale, etc., from behind the pipe, through the perforations.

It is efficient, convenient, and simple to operate, and makes the job easy and economical. Write for descriptive bulletin.

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2853-73 Cherry Ave., Long Beach, Calif.

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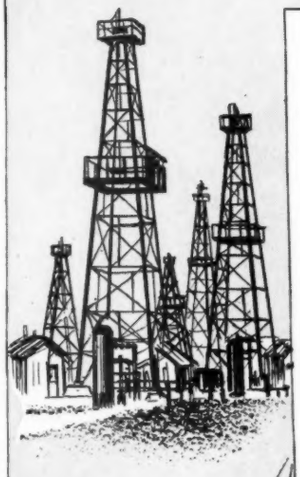
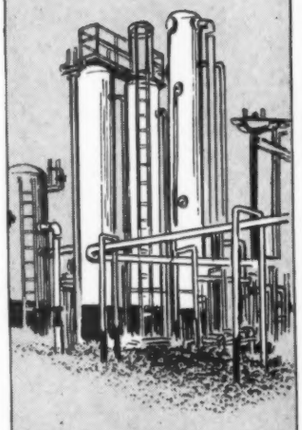
THE *Petroleum* Engineer's CONTINUOUS TABLES

A DAILY REFERENCE FOR OPERATING MEN





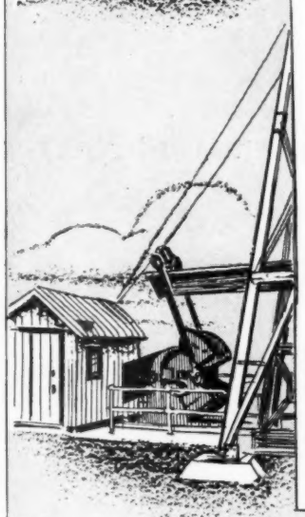
INSTALLMENT NO. 2

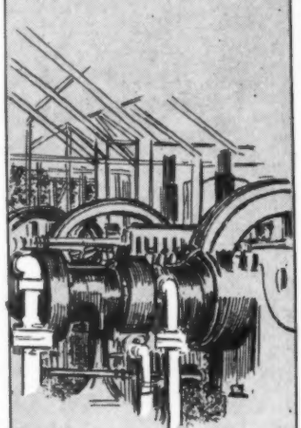
THE tables on the following pages are the first of a continuous series designed to save time and effort for the technician, and to assist the practical field or plant worker to solve problems commonly encountered in routine work. They are not intended nor expected to supplant technical training and make every man his own designer. Most of the tables can be understood and applied by anyone acquainted with the simple fundamentals of mathematics.

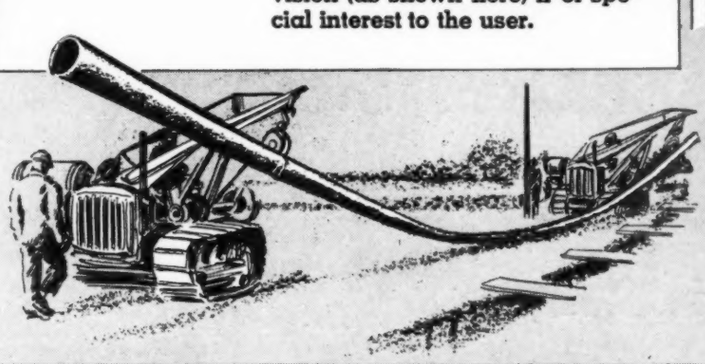
For the convenience of readers who wish to refer to the tables, each page carries in the upper right corner an index number that classifies the table according to subject matter.

All petroleum engineering literature may be indexed for reference according to the Dewey Decimal System as modified and extended for the petroleum industry by L. C. Uren, professor of petroleum engineering at the University of California. When classified according to these index numbers the material follows in a logical sequence and falls into several natural divisions, as illustrated by the following outline:

Nos. P000-P399—General
Nos. P400-P499—Drilling
Nos. P500-P599—Production
Nos. P600-P699—Transportation and Storage (includes Pipe Line)
Nos. P700-P799—Refining, including
Nos. P770-P799—Natural Gasoline, which may be classified in a separate division (as shown here) if of special interest to the user.







A REGULAR FEATURE OF THE *Petroleum* Engineer

Engineering Data Especially Compiled for Office, Field and Plant Use

INDEX TO TABLES*

(This index supersedes the index in the June issue)

Title of Table	*Index No.*	*Page*	*Issue*
Pressure conversion table	P 066	135	June
Displacement of reciprocating pumps (sheet 1)	P 094.865	123	July
(sheet 2)	P 094.865	125	July
Viscosity conversion factors	P 216.13	137	June
Heat loss from uninsulated 2-in. steam lines	P 422.335	127	July
Horizontal and vertical displacement of crooked holes	P 425.2	129	June
Weight of drill pipe and casing and volume of fluid displaced	P 425.24	121	July
Hydrostatic pressure of fluid columns of different densities	P 425.25	125	June
Amount of cement necessary to form plug about casing in well	P 444.	117	July
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Theoretical displacement of oil well plunger pumps	P 531.	119	July
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Storage capacity of gas sands	P 543.6	133	June
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Yields on cracking light and heavy oils	P 751.01	111	July
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Corrections to convert uncorrected vapor pressure to Reid vapor pressure	P 778.2	127	June

*This index is revised monthly as additional tables are published.

INDEX TO ADVERTISERS IN TABLES

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Ridge Tool Company	116	July	P 615.106.40
Staynew Filter Corporation	128	June	P 778.2
Trinity Portland Cement Company	118	July	P 444.

WEIGHT[1] OF FLUID ON PLUNGER IN PUMPING WELLS, LB. PER 100 FT.

Plunger diameter, in.	Rod diameter, in.	Wt. of rods, lb. per 100 ft.	Average gravity of liquid, deg. A.P.I.									
			16	20	24	28	32	36	40	44	48	52
1	5/8	110	20	19	19	18	18	17	17	17	16	16
	3/4	162	14	14	14	13	13	13	12	12	12	11
1 1/16	5/8	110	24	23	23	22	22	21	21	20	20	19
	3/4	162	18	18	18	17	17	16	16	16	15	15
1 1/4	5/8	110	38	37	36	35	34	34	33	32	31	31
	3/4	162	33	32	31	30	29	29	28	27	27	26
1 1/2	5/8	110	61	59	58	56	55	53	52	51	50	49
	3/4	162	55	54	52	51	50	48	47	46	45	44
	7/8	235	48	47	46	45	44	43	42	41	40	39
	1	295	41	40	39	38	37	36	35	34	34	33
1 3/4	5/8	110	87	85	83	81	79	77	75	73	72	70
	3/4	162	82	79	77	75	74	72	70	69	67	66
	7/8	235	75	73	71	69	68	66	64	63	62	60
	1	295	67	66	64	62	61	59	58	57	55	54
1.7810	5/8	110	91	88	86	84	82	80	78	76	75	73
	3/4	162	85	83	81	79	77	75	73	72	70	68
	7/8	235	79	76	74	73	71	69	68	66	65	63
	1	295	71	69	67	66	64	62	61	60	58	57
2	5/8	110	118	115	112	109	106	104	101	99	97	95
	3/4	162	112	109	106	104	101	99	96	94	92	90
	7/8	235	106	103	100	98	95	93	91	89	87	85
	1	295	98	95	93	91	88	86	84	82	80	79
2 1/4	5/8	110	152	148	145	141	138	134	131	128	125	123
	3/4	162	147	143	139	136	132	129	126	123	121	118
	7/8	235	140	137	133	130	126	123	121	118	115	113
	1	295	133	129	126	123	120	117	114	111	109	107
2 1/2	5/8	110	191	186	181	177	172	168	164	161	157	154
	3/4	162	186	181	176	172	167	163	160	156	153	149
	7/8	235	179	174	170	165	161	158	154	150	147	144
	1	295	171	167	163	158	155	151	147	144	141	138
2 3/4	5/8	110	234	228	222	216	211	206	201	197	192	188
	3/4	162	228	222	217	211	206	201	196	192	188	184
	7/8	235	222	216	210	205	200	195	191	186	182	178
	1	295	214	208	203	198	193	189	184	180	176	172
3	3/4	162	275	268	261	255	248	242	237	231	226	221
	7/8	235	269	262	255	248	242	237	231	226	221	216
	1	295	261	254	248	241	236	230	225	219	215	210
3 1/4	3/4	162	326	318	310	302	294	287	281	274	268	262
	7/8	235	320	311	303	296	288	282	275	269	263	257
	1	295	312	304	296	289	281	275	268	262	256	251
3 3/4	3/4	162	441	429	418	407	397	388	379	370	362	354
	7/8	235	434	422	412	401	391	382	373	365	357	349
	1	295	426	415	404	394	385	375	367	358	350	343
4 1/4	3/4	162	571	556	542	528	515	503	491	480	469	459
	7/8	235	564	550	535	522	509	497	485	474	464	454
	1	295	557	542	528	515	502	490	479	468	458	448
4 3/4	3/4	162	718	699	681	664	648	632	617	603	590	577
	7/8	235	711	692	675	658	642	626	612	598	585	572
	1	295	704	685	667	651	635	620	605	591	578	566

[1]At 60 deg. fahrenheit. No allowance has been made for expansion of oil at the temperatures ordinarly encountered in wells. No allowance has been made for the lifting effect of any gas that may be present.

MISSION Valveless SWAB

PARRISH PATENTS

TANDEM MODEL

asssures you

3 to 15 TIMES FASTER SWABBING

- protecting the sand
- earning quicker profits by getting oil into the tanks quicker

because of

UNIQUE SPLIT-RUBBER PRINCIPLE

NO BALLS AND SEATS WHICH ARE FREQUENTLY CLOGGED OR FOULED IN PARAFFIN OR HARD FORMATIONS

Foreign matter such as pieces of soft rope, rubber, small sticks or other obstructions frequently hold open the valve of conventional type swab, causing it to come out without a load. **The Mission Valveless Swab brings up a load under these conditions that so often cause other swabs to come up empty.**

LESS FRICTIONAL WEAR GOING DOWN INTO THE HOLE... GREATLY REDUCING RUBBER MAINTENANCE

Rubber passes freely through tubing on down stroke. Thus a large proportion of the friction wear of the rubbers against tubing is eliminated.

WILL NOT HIT FLUID A SOLID BLOW AND KINK LINE

The Mission Valveless Swab will show only a slight check on reaching fluid. This should be watched carefully on first run to determine fluid level. This characteristic of Mission Swabs is made possible by the large by-pass. **Saving lines from kinking means saving money on line maintenance.**

GOES DOWN FAST THROUGH PARAFFIN OR GAS

Often when other swabs will not go in the hole, the Mission Valveless Swab falls like a plummet.

SWAB CAN BE USED AS A PARAFFIN KNIFE

Simply remove the rubbers and the rubber holders become paraffin knives.

GREAT STRENGTH MAKES FOR SAFETY AND ECONOMY

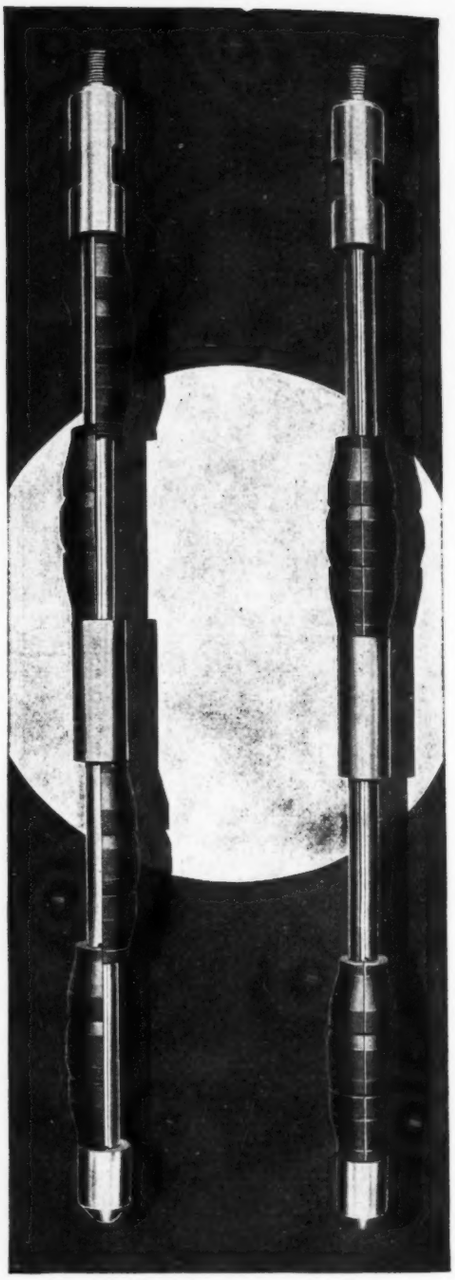
Solid alloy heat-treated mandrel as against hollow mandrel of conventional makes.

SAFEST TO OPERATE

The Mission Swab will not blow out of the hole when pulling load as gas pressure will open split-rubber, permitting gas to by-pass, resuming its load without loss after gas has passed. **No loose line over derrick floor to endanger crew.**

CUTS DOWN FIRE HAZARDS

Since the Mission Swab will not blow out of the hole under conditions that blow the conventional type swab out of the hole, the resultant possibility of sparks from this cause is eliminated.



DOWN STROKE
Note that half of each rubber has raised above stationary half . . allowing an area for fluid passage larger than the area of flow around the A.P.I. pin.

UP STROKE
Note that movable half of each rubber has dropped back beside its other half. Rubbers now in swabbing position.

SEND FOR FOLDER AND DETAILS ON

MISSION'S UNUSUAL TIME AND TROUBLE SAVING RECORDS under various conditions in various major areas, including:

- **MID-CONTINENT**
- **GULF COAST**
- **CALIFORNIA**
- **ROCKY MOUNTAIN AREA**

MISSION MANUFACTURING CO.

HUMBLE ROAD - - - - - - - - - - - - - - - - - HOUSTON, TEXAS

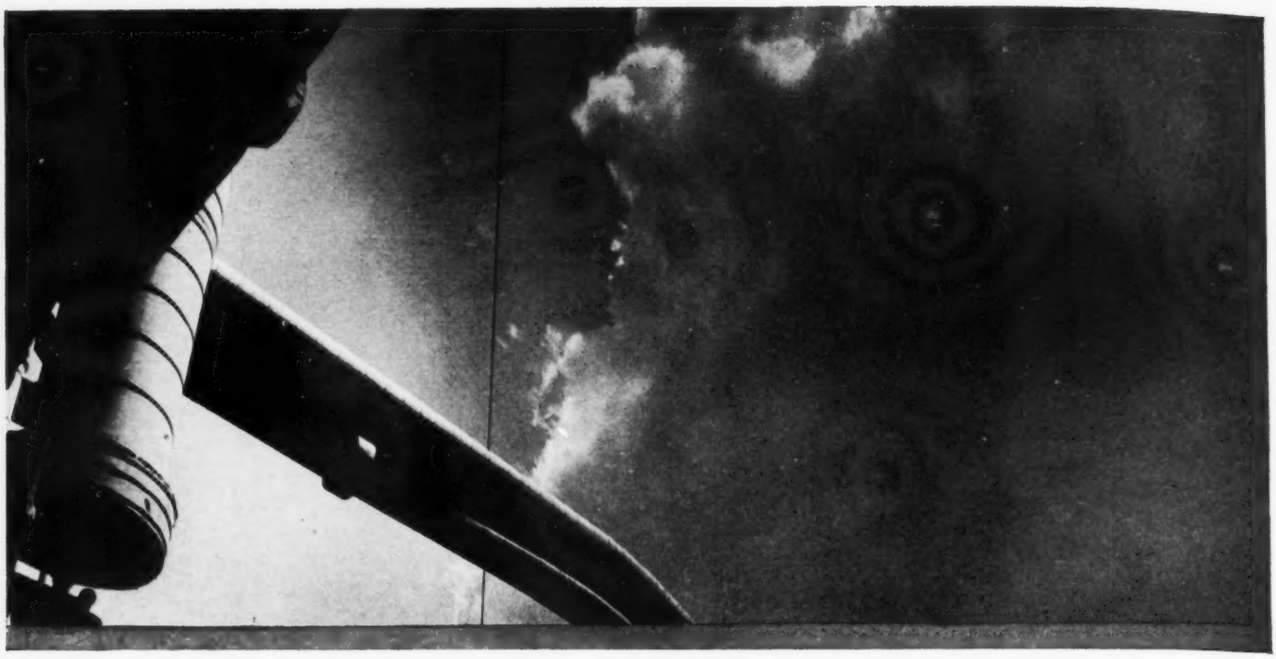
Mission Slips . . Mission Valves . . Mission Pistons . . Mission Piston Rods . . Mission Swabs

Sold Through Supply Stores Everywhere

YIELDS ON CRACKING LIGHT AND HEAVY OILS

Characteristics of charging stock					Cracking conditions		Yield				Gravity of residuum, °A.P.I.	Characteristics of gasoline fraction		
Type of material	Geographic source	Gravity, °A.P.I.	Octane number	Sulphur, percent	Temp., deg. fahr.	Pressure, lb. per sq. in.	Gasoline, percent	Gas and loss, percent	Gas, cu. ft. per bbl. charge	Residuum percent		Gravity, °A.P.I.	Octane number	Sulphur, percent
Gasoline	Pennsylvania	64.6	50	....	1000	400	76.7	21.9	704	1.4	.....	63.6	75	0.01
Gasoline	East and West Texas	61.3	59	....	995	450	85.8	15.6	400	0.0	.....	61.0	73	0.09
Gasoline	Mid-Continent	59.8	42	0.02	975	500	82.3	16.5	395	1.2	.....	60.9	70	0.01
Gasoline	East Texas	58.7	56	0.02	950	500	84.4	14.6	403	1.0	.....	58.8	75	0.02
Gasoline	East Texas	58.7	56	0.02	950	500	88.1	9.2	244	2.7	.....	60.6	71	0.02
Gasoline	West Texas	58.1	61	0.18	950	750	87.4	10.6	342	2.0	.....	59.6	78	0.05
Naphtha	Pennsylvania	54.9	31	....	950	500	73.5	16.4	560	10.1	.....	58.1	76	0.02
Naphtha	Mid-Continent	53.5	34	0.02	1000	500	75.5	22.0	781	2.5	.....	55.5	75	0.02
Naphtha	West Texas	51.5	52	0.19	950	750	80.4	13.7	451	5.9	.....	54.8	78	0.07
Gas oil	Pennsylvania	38.8	....	0.05	950	350	70.5	18.5	460	11.0	7.3	62.2	76	0.02
Gas oil	Mid-Continent	35.3	....	0.32	965	350	65.2	19.7	698	15.1	7.0	61.0	80	.....
Gas oil	California	34.5	....	0.59	950	350	70.8	15.9	487	13.3	0.1	57.9	77	0.24
Gas oil	East Texas	32.0	....	0.23	950	350	61.8	16.2	640	22.0	3.6	60.5	75	0.10
Gas oil	Coastal	28.5	....	0.1	950	400	63.8	17.9	796	18.3	—1.5	52.8	90	0.05
Gas oil	California	26.1	....	0.99	950	350	61.3	9.7	520	29.0	4.4	55.6	79	.....
Fuel oil	New Mexico (Hobbs)	27.8	....	....	935	350	63.3	7.5	391	29.2	3.7	56.0	76	.....
Fuel oil	Montana (Kevin-Sunburst)	27.3	....	....	950	300	60.2	10.7	505	29.1	3.6	57.1	81	.....
Fuel oil	Mid-Continent	25.3	....	....	915	250	51.2	7.0	309	41.8	9.5	61.0	72	.....
Fuel oil	Kentucky	23.4	....	....	900	265	55.1	4.0	298	40.9	9.1	58.3	76	.....
Fuel oil	California (Santa Fe Springs)	19.8	....	....	929	250	40.7	6.1	312	53.2	8.3	58.1	75	.....
Fuel oil	California	17.8	....	....	890	250	38.9	3.0	290	58.1	8.9	59.0	79	.....
Topped crude	Arkansas (Smackover)	17.9	....	2.2	935	200	39.0	2.6	251	58.4	8.7	57.1	80	0.24
		17.9	....	2.2	935	200	45.2	6.8	408	48.0	4.8	57.0	80	0.24
		17.9	....	2.2	935	200	48.8	5.2	458	46.0	2.6	55.3	80	0.22
		17.9	....	2.2	935	200	50.2	5.0	446	44.8	0.7	55.6	80	0.25
		17.9	....	2.2	935	200	63.1	36.9	970	None	Coke	55.1	80	0.26

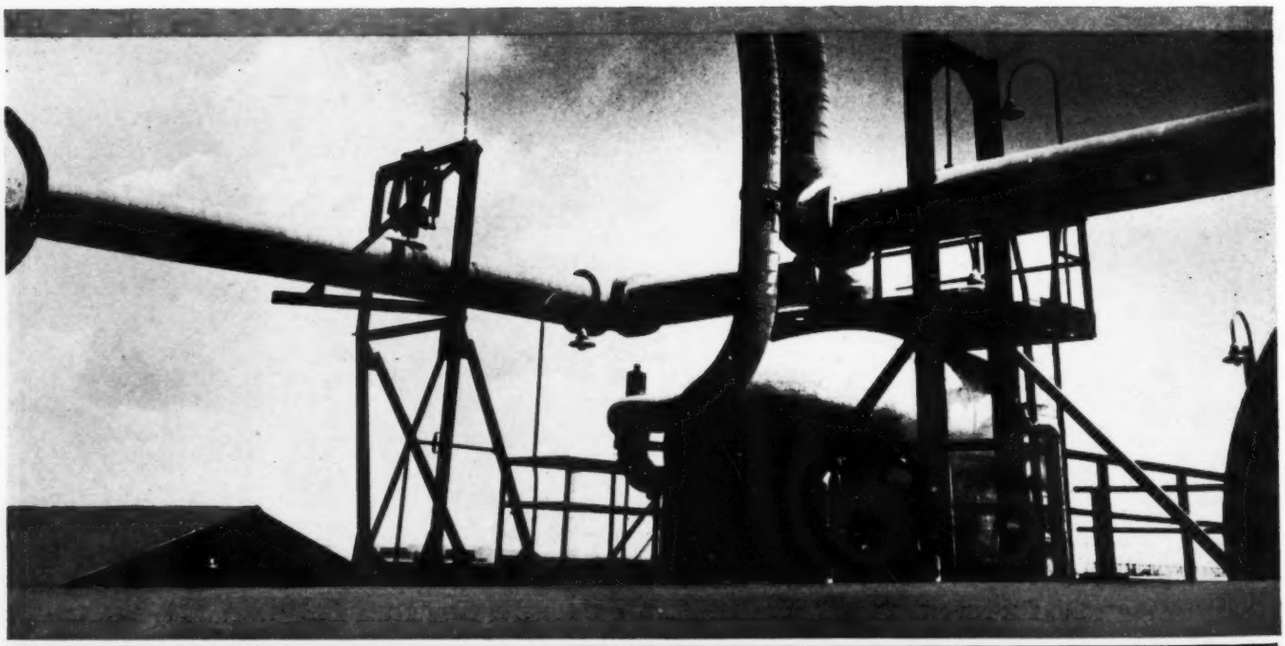
Adapted from Egloff and Nelson's paper, "Cracking Light and Heavy Oils," presented at American Petroleum Institute meeting, Tulsa, Oklahoma, May 19, 1933.



THERE IS NO STANDING STILL!

Refiners are constantly faced with change—change in standards of quality—change in proportion of various products required to meet marketing conditions—change in cracking technique—design—equipment.

Gasoline Products Company, Inc., as licensor of modern cracking processes, is in a position to assist refiners to meet these changes and protect present as well as future profits!



LICENSES granted under United States and Foreign Patents for Cross, de Florez, Holmes-Manley, Tube and Tank Cracking Processes, Uni-Coil Injection Process and Combination Cracking Units
Licensing Agents: THE M. W. KELLOGG CO., Jersey City, New Jersey, or its *European Representative*, COMPAGNIE TECHNIQUE des PETROLES, 134 Boulevard Haussmann, Paris, France

GASOLINE PRODUCTS COMPANY

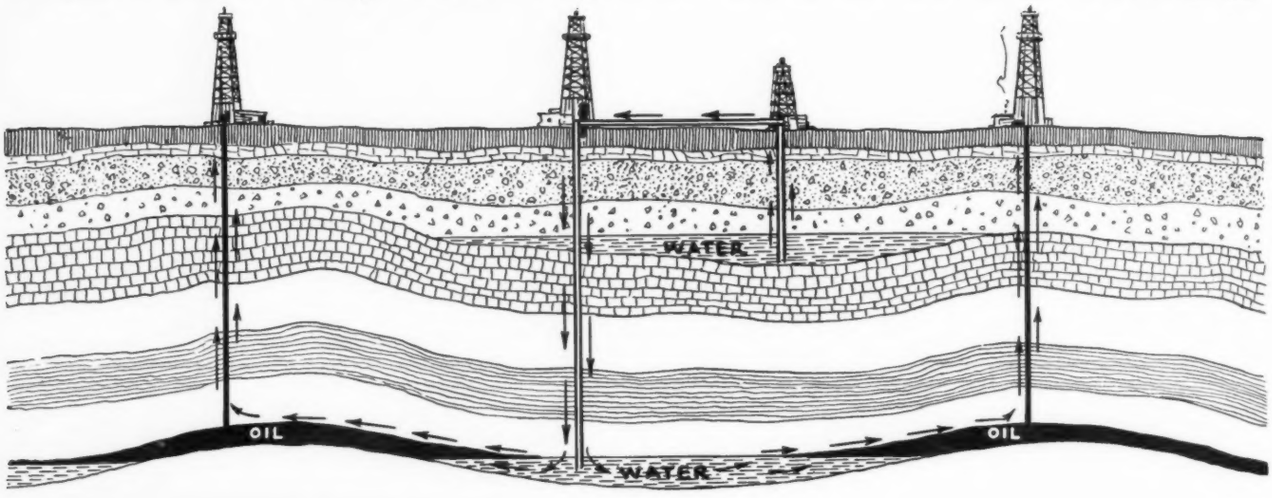
INCORPORATED

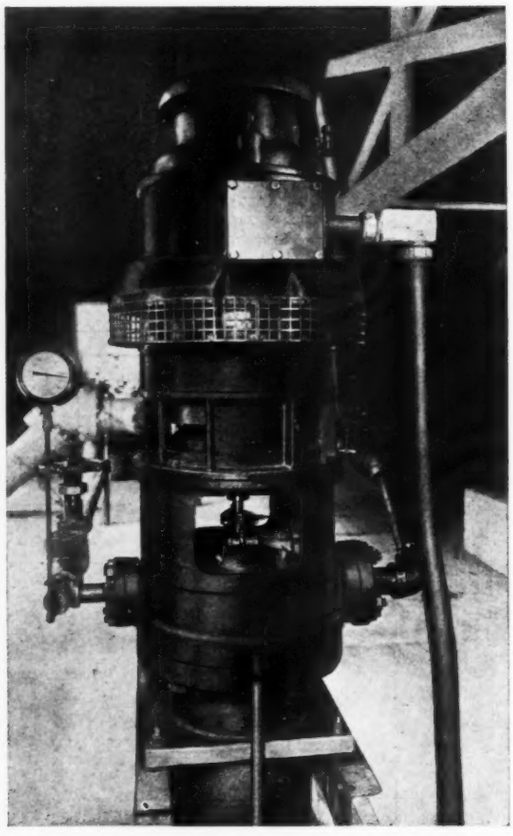
11 COMMERCE STREET · NEWARK, NEW JERSEY

BARRELS OF FLOOD WATER REQUIRED PER ACRE, 100 PERCENT SATURATION

Sand thickness, feet	Percent porosity of sand								
	10	12	14	16	18	20	22	24	26
½	388	466	543	621	698	776	853	931	1,009
1	776	931	1,086	1,241	1,397	1,552	1,707	1,862	2,017
1½	1,164	1,397	1,629	1,862	2,095	2,328	2,560	2,793	3,026
2	1,552	1,862	2,172	2,483	2,793	3,103	3,414	3,724	4,034
2½	1,940	2,328	2,715	3,103	3,491	3,879	4,267	4,655	5,043
3	2,328	2,793	3,259	3,724	4,190	4,655	5,121	5,586	6,052
3½	2,715	3,259	3,802	4,345	4,888	5,431	5,974	6,517	7,060
4	3,103	3,724	4,345	4,965	5,586	6,207	6,827	7,448	8,069
4½	3,491	4,190	4,888	5,586	6,284	6,983	7,681	8,379	9,077
5	3,879	4,655	5,431	6,207	6,983	7,758	8,534	9,310	10,086
6	4,655	5,586	6,517	7,748	8,379	9,310	10,241	11,172	12,103
7	5,431	6,517	7,603	8,690	9,776	10,862	11,948	13,034	14,120
8	6,207	7,448	8,690	9,931	11,172	12,414	13,655	14,896	16,138
9	6,983	8,379	9,776	11,172	12,569	13,965	15,362	16,758	18,155
10	7,758	9,310	10,862	12,414	13,965	15,517	17,069	18,620	20,172
11	8,534	10,241	11,948	13,655	15,362	17,069	18,776	20,482	22,189
12	9,310	11,172	13,034	14,896	16,758	18,620	20,482	22,344	24,206
13	10,086	12,103	14,120	16,138	18,155	20,172	22,189	24,207	26,224
14	10,862	13,034	15,207	17,379	19,551	21,724	23,896	26,069	28,241
15	11,638	13,965	16,293	18,620	20,948	23,276	25,603	27,931	30,258
16	12,414	14,896	17,379	19,862	22,344	24,827	27,310	29,793	32,275
17	13,189	15,827	18,465	21,103	23,741	26,379	29,017	31,655	34,293
18	13,965	16,758	19,551	22,344	25,138	27,931	30,724	33,517	36,310
19	14,741	17,689	20,638	23,586	26,534	29,482	32,431	35,379	38,327
20	15,517	18,620	21,724	24,827	27,931	31,034	34,137	37,241	40,344
21	16,293	19,551	22,810	26,069	29,327	32,586	35,844	39,103	42,361
22	17,069	20,482	23,896	27,310	30,724	34,137	37,551	40,965	44,379
23	17,844	21,413	24,982	28,581	32,120	35,689	39,258	42,827	46,396
24	18,620	22,344	26,069	29,793	33,517	37,241	40,965	44,689	48,413
25	19,396	23,276	27,155	31,034	34,913	38,792	42,672	46,551	50,430
26	20,172	24,207	28,241	32,275	36,310	40,344	44,379	48,413	52,447
27	20,947	25,138	29,327	33,517	37,706	41,896	46,085	50,275	54,465
28	21,724	26,069	30,413	34,758	39,103	43,448	47,792	52,137	56,482
29	22,500	27,000	31,500	35,999	40,499	44,999	49,499	53,999	58,499
30	23,275	27,931	32,586	37,241	41,896	46,551	51,206	55,861	60,516
31	24,051	28,862	33,672	38,482	43,292	48,103	52,913	57,723	62,534
32	24,827	29,793	34,758	39,724	44,689	49,654	54,620	59,585	64,551
33	25,603	30,724	35,844	40,965	46,085	51,206	56,327	61,447	66,568
34	26,379	31,655	36,930	42,206	47,482	52,758	58,034	63,309	68,585
35	27,155	32,586	38,017	43,448	48,879	54,310	59,740	65,171	70,602
36	27,931	33,517	39,103	44,689	50,275	55,861	61,447	67,033	72,620
37	28,706	34,448	40,189	45,930	51,672	57,413	63,154	68,895	74,637
38	29,482	35,379	41,275	47,172	53,068	58,965	64,861	70,758	76,654
39	30,258	36,310	42,361	48,413	54,465	60,516	66,568	72,620	78,671
40	31,034	37,241	43,448	49,654	55,861	62,068	68,275	74,482	80,688
45	34,913	41,896	48,879	55,861	62,844	69,826	76,809	83,792	90,774
50	38,792	46,551	54,310	62,068	69,826	77,585	85,344	93,102	100,860
55	42,672	51,206	59,740	68,275	76,809	85,344	93,878	102,412	110,947
60	46,551	55,861	65,171	74,482	83,792	93,102	102,412	111,722	121,033
65	50,430	60,516	70,602	80,688	90,774	100,860	110,947	121,033	131,119
70	54,309	65,171	76,033	86,895	97,757	108,619	119,481	130,343	141,205
75	58,189	69,826	81,464	93,102	104,740	116,378	128,015	139,653	151,291
80	62,068	74,482	86,895	99,309	111,722	124,136	136,550	148,963	161,377
85	65,947	79,137	92,326	105,516	118,705	131,894	145,084	158,273	171,463
90	69,826	83,792	97,757	111,722	125,688	139,653	153,618	167,584	181,549
95	73,706	88,447	103,188	117,929	132,670	147,412	162,153	176,894	191,635
100	77,585	93,102	108,619	124,136	139,653	155,170	170,687	186,204	201,721

FOR SUCCESSFUL RE-PRESSURING
You can depend upon HYDROPRESS





This re-pressuring application shows a 15-inch, 17-stage HYDROPRESS. *Vibrationless operation is shown by the steadiness of the gauge under high pressure.*

The recovery of additional oil by pumping down water for re-pressuring the oil-bearing strata is proving highly successful in many fields.

Byron Jackson HYDROPRESS Pumps have proved ideal for re-pressuring service, where pressures as high as 2,500 pounds per square inch may be required.

A typical re-pressuring operation is shown in the above illustration, which may suggest a profitable solution of YOUR recovery problems.

•

Our office nearest you will be glad to work with you and submit recommendations . . . naturally without obligation on your part.

•

Established 1872

BYRON JACKSON CO.

Factories at: Berkeley · LOS ANGELES · Bethlehem
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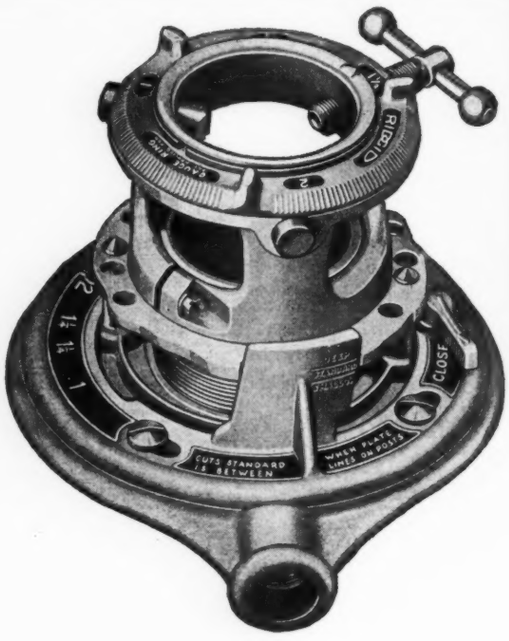
BYRON JACKSON

CENTRIFUGAL PUMPS FOR EVERY SERVICE

PRESSURE DROP, LB. PER SQ. IN. PER MILE OF 6-in. PIPE LINE

Quantity of 40° A.P.I. oil, bbl. per hr.	Viscosity of oil, Saybolt Universal seconds										
	50	60	70	80	90	100	110	120	130	140	150
200	5.00	5.55	5.82	6.06	6.28	6.47	6.66	6.82	6.99	7.12	7.26
205	5.22	5.79	6.08	6.34	6.57	6.76	6.96	7.13	7.30	7.45	7.59
210	5.44	6.04	6.34	6.61	6.85	7.04	7.25	7.43	7.61	7.76	7.91
215	5.66	6.29	6.61	6.89	7.14	7.35	7.56	7.75	7.94	8.09	8.25
220	5.89	6.55	6.88	7.17	7.44	7.65	7.88	8.07	8.27	8.43	8.59
225	6.12	6.81	7.15	7.46	7.74	7.97	8.20	8.40	8.60	8.77	8.94
230	6.36	7.07	7.43	7.76	8.05	8.28	8.53	8.74	8.94	9.12	9.30
235	6.60	7.34	7.72	8.05	8.36	8.60	8.86	9.08	9.29	9.47	9.65
240	6.84	7.61	8.00	8.36	8.67	8.93	9.19	9.42	9.65	9.84	10.02
245	7.09	7.88	8.29	8.66	8.99	9.25	9.53	9.77	10.01	10.20	10.40
250	7.33	8.16	8.57	8.96	9.30	9.58	9.86	10.11	10.36	10.56	10.76
255	7.59	8.44	8.88	9.27	9.62	9.91	10.21	10.47	10.72	10.94	11.15
260	7.84	8.73	9.18	9.59	9.95	10.25	10.56	10.83	11.09	11.32	11.54
265	8.10	9.03	9.50	9.92	10.29	10.59	10.92	11.20	11.47	11.70	11.93
270	8.36	9.32	9.81	10.25	10.63	10.94	11.28	11.56	11.85	12.09	12.33
275	8.63	9.62	10.13	10.58	10.98	11.30	11.65	11.93	12.23	12.48	12.73
280	8.91	9.92	10.44	10.91	11.33	11.66	12.02	12.32	12.62	12.87	13.13
285	9.19	10.23	10.77	11.25	11.68	12.03	12.40	12.71	13.02	13.28	13.54
290	9.46	10.52	11.08	11.59	12.03	12.39	12.77	13.09	13.41	13.67	13.94
295	9.74	10.83	11.41	11.93	12.39	12.76	13.16	13.49	13.82	14.08	14.36
300	10.03	11.15	11.74	12.28	12.76	13.13	13.55	13.89	14.24	14.50	14.77
305	10.32	11.48	12.07	12.63	13.12	13.52	13.95	14.30	14.65	14.93	15.21
310	10.61	11.81	12.42	12.98	13.49	13.90	14.34	14.71	15.07	15.36	15.65
315	10.90	12.14	12.77	13.34	13.87	14.28	14.74	15.12	15.50	15.80	16.09
320	11.19	12.47	13.13	13.70	14.24	14.67	15.15	15.54	15.93	16.23	16.54
325	11.49	12.80	13.47	14.06	14.61	15.05	15.54	15.94	16.34	16.66	16.98
330	11.81	13.14	13.83	14.44	14.99	15.45	15.95	16.36	16.78	17.10	17.43
335	12.12	13.48	14.20	14.82	15.39	15.86	16.38	16.79	17.22	17.55	17.89
340	12.44	13.82	14.56	15.21	15.79	16.27	16.81	17.22	17.66	18.00	18.35
345	12.76	14.17	14.93	15.59	16.19	16.69	17.24	17.66	18.10	18.46	18.81
350	13.09	14.52	15.30	15.98	16.60	17.12	17.68	18.12	18.57	18.92	19.28
355	13.41	14.87	15.68	16.38	17.01	17.54	18.13	18.57	19.03	19.39	19.75
360	13.74	15.24	16.05	16.77	17.42	17.97	18.57	19.03	19.50	19.87	20.23
365	14.06	15.60	16.42	17.16	17.83	18.39	19.01	19.48	19.97	20.35	20.71
370	14.40	15.98	16.80	17.56	18.25	18.82	19.46	19.94	20.44	20.83	21.20
375	14.73	16.36	17.20	17.96	18.67	19.26	19.91	20.41	20.92	21.33	21.71
380	15.07	16.74	17.60	18.37	19.09	19.70	20.37	20.88	21.41	21.82	22.21
385	15.41	17.12	18.01	18.78	19.52	20.15	20.83	21.35	21.90	22.32	22.72
390	15.75	17.51	18.42	19.19	19.95	20.59	21.29	21.83	22.39	22.82	23.24
395	16.12	17.90	18.83	19.60	20.38	21.04	21.76	22.31	22.88	23.33	23.75
400	16.48	18.28	19.24	20.02	20.80	21.48	22.22	22.78	23.37	23.82	24.26
405	16.85	18.68	19.66	20.46	21.24	21.93	22.69	23.27	23.87	24.34	24.78
410	17.22	19.07	20.08	20.90	21.70	22.41	23.16	23.76	24.37	24.85	25.31
415	17.60	19.47	20.50	21.34	22.16	22.89	23.66	24.25	24.88	25.37	25.84
420	17.98	19.87	20.93	21.79	22.63	23.37	24.16	24.76	25.39	25.89	26.37
425	18.36	20.28	21.36	22.24	23.10	23.86	24.67	25.29	25.90	26.41	26.91
430	18.75	20.68	21.79	22.70	23.58	24.35	25.18	25.81	26.42	26.94	27.45
435	19.14	21.09	22.22	23.15	24.05	24.85	25.70	26.34	26.96	27.50	28.01
440	19.52	21.49	22.65	23.59	24.51	25.33	26.20	26.86	27.49	28.04	28.56
445	19.91	21.90	23.09	24.06	25.00	25.83	26.72	27.39	28.04	28.60	29.14
450	20.31	22.34	23.53	24.52	25.48	26.33	27.24	27.93	28.59	29.17	29.72
455	20.71	22.79	23.97	24.98	26.00	26.84	27.77	28.47	29.15	29.74	30.30
460	21.11	23.24	24.42	25.45	26.49	27.35	28.30	29.02	29.71	30.31	30.89
465	21.51	23.69	24.86	25.92	26.98	27.86	28.83	29.56	30.27	30.89	31.47
470	21.92	24.14	25.31	26.39	27.47	28.38	29.37	30.12	30.84	31.47	32.07
475	22.33	24.60	25.76	26.90	27.97	28.89	29.90	30.67	31.41	32.05	32.66
480	22.73	25.04	26.23	27.39	28.49	29.39	30.43	31.21	31.96	32.62	33.25
485	23.14	25.51	26.72	27.90	29.02	29.92	30.97	31.77	32.54	33.21	33.85
490	23.56	25.97	27.21	28.42	29.56	30.47	31.52	32.33	33.12	33.80	34.45
495	23.98	26.44	27.70	28.94	30.10	31.03	32.07	32.90	33.70	34.40	35.06
500	24.40	26.91	28.20	29.46	30.65	31.60	32.62	33.47	34.28	35.00	35.68



ONLY 4 CHASER DIES

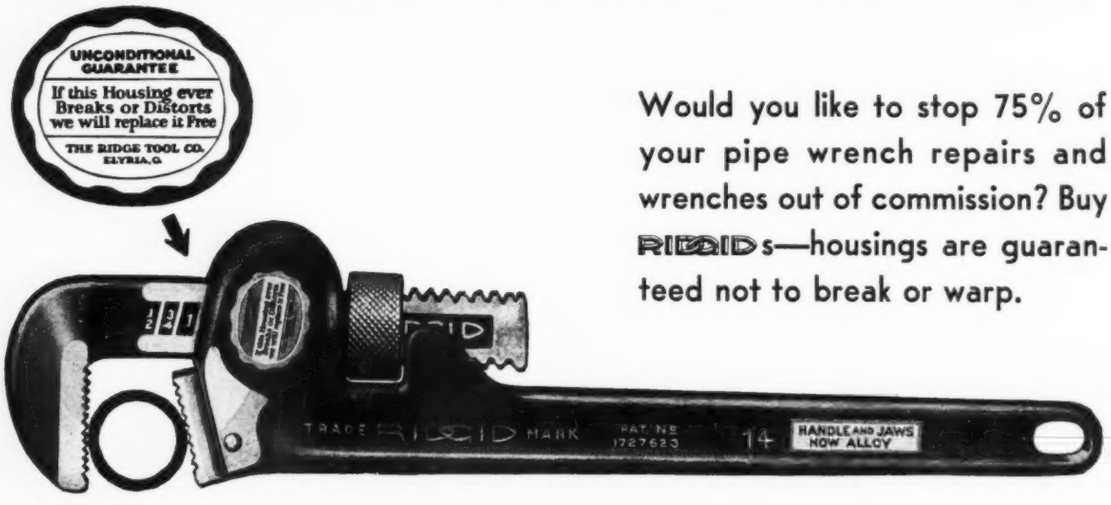
INSTEAD OF 16

This RIDGID No. 65R threads 1" to 2" pipe—without changing dies perfect, accurate threads. One set of 4 dies—no bother changing, forget the other 12 you don't need. You'll like this RIDGID No. 65R. Write for folder, or see it at your supply store.

No. 65 R

No. 65 Plain Die

A RIDGID PIPE TOOL


UNCONDITIONAL GUARANTEE
If this Housing ever Breaks or Distorts we will replace it Free
THE RIDGE TOOL CO. ELYRIA, O.
RIDGID
TRADE RIDGID MARK
PAT. NO 1727623
14
HANDLE AND JAWS NOW ALLOY

Would you like to stop 75% of your pipe wrench repairs and wrenches out of commission? Buy RIDGIDs—housings are guaranteed not to break or warp.

THE RIDGE TOOL CO. . . . ELYRIA, OHIO

AMOUNT OF CEMENT (SACKS) NECESSARY TO FORM CEMENT PLUG ABOUT CASINGS OF VARIOUS SIZES IN WELLS OF DIFFERENT DIAMETERS

Casing size, inches	Diameter of drill hole, inches																								
	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
4¾	7	13	20	29	39	48																			
	6	11	18	26	35	43																			
	5	10	16	23	31	39																			
5	5	12	19	28	37	48																			
	5	11	17	25	33	43																			
	4	10	15	23	30	39																			
5½		9	17	25	35	46	56	67																	
		8	15	22	31	41	50	60																	
		7	14	20	28	37	45	54																	
5¾		8	15	24	33	44	56	67	83																
		7	13	22	29	39	50	60	75																
		6	12	19	26	35	45	54	67																
6⅝			10	19	28	39	50	63	77	91															
			9	17	25	35	45	57	69	82															
			8	15	23	31	40	51	62	74															
7			7	16	25	36	48	59	71	91	100														
			6	14	22	32	43	53	64	82	90														
			5	13	20	29	39	47	57	74	81														
7⅝				11	21	31	42	56	67	84	100	111													
				10	19	28	38	50	60	75	90	100													
				9	17	25	34	45	54	67	81	90													
8⅛					17	22	39	50	63	77	91	111													
					15	20	35	45	57	69	82	100													
					14	18	31	40	51	62	74	90													
8⅝					13	23	35	48	59	77	91	111	125												
					11	21	31	43	53	69	82	100	112												
					10	19	28	39	47	62	74	90	100												
9						20	31	44	56	71	83	100	125												
						18	28	39	50	64	75	90	112												
						16	25	35	45	57	67	81	100												
9⅝						14	26	39	53	67	83	100	111												
						12	23	35	47	60	75	90	100												
						11	21	31	42	54	67	81	90												
10¾							14	26	40	56	71	83	100	125											
							12	23	36	50	64	75	90	112											
							11	21	32	45	57	67	81	100											
11¾								15	29	44	59	77	91	111	125										
								13	26	39	53	69	82	100	112										
								12	23	35	47	62	74	90	100										
13										28	44	59	77	91	111	143									
										25	39	53	69	82	100	128									
										23	35	47	62	74	90	114									
13⅜										23	39	56	71	91	111	125	143								
										21	35	50	64	82	100	112	128								
										19	31	45	57	74	90	100	114								
16													33	53	71	91	111	143							
													29	47	64	82	100	128							
													26	42	57	74	90	114							
18⅝															26	48	67	91	111	143					
															23	43	60	82	100	128					
															21	39	54	74	90	114					
20																	42	63	91	111	143	167			
																	38	57	82	100	128	150			
																	34	51	74	90	114	135			
21½																		33	56	83	111	125	167		
																		29	50	75	100	112	150		
																		26	45	67	90	100	135		
24½																					37	63	91	125	143
																					33	57	82	112	128
																					30	51	74	100	114

The figures in the body of the table represent the number of sacks of cement required to form a plug 100 ft. in length.

The calculations are based on a weight of 94 lb. per sack.

The three quantities shown for each size casing and each size drill hole are for three water-cement ratios, as follows:

5 gal. water per sack.
6 gal. water per sack.
7 gal. water per sack.

TWO GREAT OILWELL CEMENTS!

TRINITY *Inferno* And TRINITY *High Early Strength* PORTLAND CEMENTS

WHATEVER your cementing problem, you will find one of these cements perfectly suited to do the job.

Under ordinary conditions, many operators prefer TRINITY *"High Early Strength."* It mixes, pumps and flows easily at all weights up to 16 pounds, assuring a strong, dense, permanent shut-off or plugback. DEPENDABLE high early strength permits drilling out in one day.

For deep drilling—or where bottom hole temperatures are high, TRINITY *"Inferno"* is a favorite. "Inferno" is specially manufactured for use in deep, hot holes and for use where sulphate waters are present. Regardless of heat and pressure, its controlled setting time gives you a margin of safety in pumping down. A slurry that pumps freely at 16 pounds or better—and a slurry that does not set in the casing. In addition, it has other desirable qualities found in TRINITY *"High Early Strength."*

Use TRINITY *"Inferno"* or *"High Early Strength"* next time, depending on the job to be done—you'll find it pays to play safe with *Trinity.*

TWO PORTLAND CEMENTS FOR OIL WELL CEMENTING

PROPERTIES	HIGH EARLY STRENGTH	INFERNO
Pumpability	Pumps freely with plenty of time to "pump down" at all weights to 16 lbs. under 140 degrees F.	Pumps freely with plenty of time to "pump down" at all weights to 16.5 lbs. over 140 degrees F.
Strength	Permits drilling out in 1 day.	Permits drilling out in 2 to 3 days.
Impermeability	Produces dense, hard slurry which provides permanent shut-off.	
Bond	Excellent bond to casing, no contraction after setting.	
Resistance to Contamination	Heavy "body" reduces contamination.	
Resistance to Sulphate Waters	Good	Highly resistant under abnormal temperature and pressure conditions.

Photo (inset) at right shows TRINITY *"High Early Strength" going on location. W. B. McKee No. 4 at Overton in East Texas.*

(Right, below) Cementing James McDougal No. 1, Hidalgo County, Texas, with 1000 bags TRINITY *"Inferno." Depth, 8040 feet. Temperature, 197° F*

REG. U. S. PAT. OFF.

PORTLAND CEMENT COMPANY TRINITY TRINITY TRINITY

COWHAM SYSTEM

YOUR LOCAL LUMBER AND BUILDING MATERIAL DEALER CAN SUPPLY YOU

TRINITY PORTLAND CEMENT COMPANY

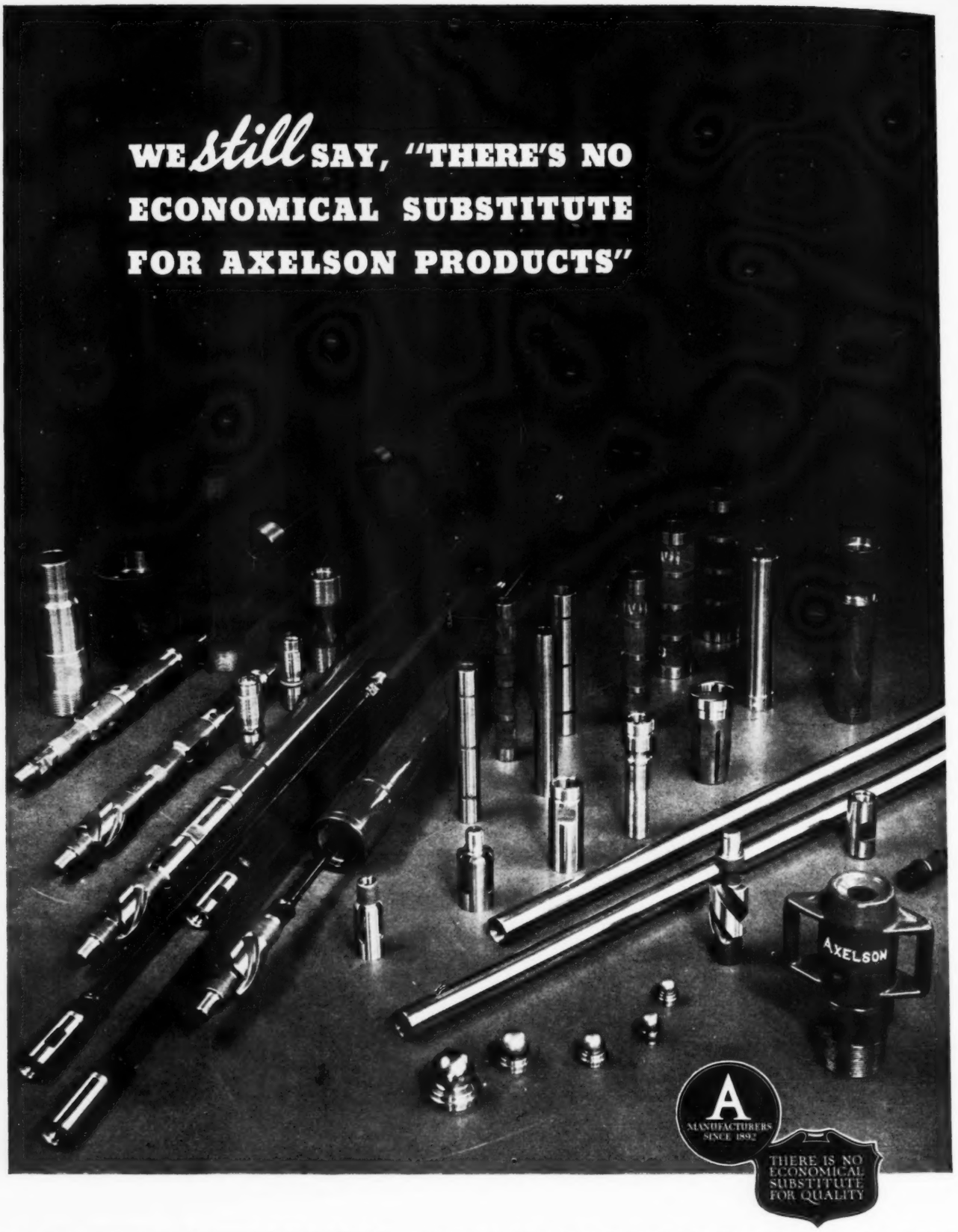
Manufacturers of Trinity Standard Portland Cement, Trinity "High Early Strength" Portland Cement, Trinity "Inferno" Portland Cement and Trinity-Mix Masonry Cement

DALLAS • FORT WORTH • HOUSTON

THEORETICAL DISPLACEMENT OF OIL WELL PLUNGER PUMPS, BBL. PER HR.

Speed × Stroke[1]	Plunger diameter, in.												
	1	1¼	1½	1¾	2	2¼	2½	2¾	3	3¼	3¾	4¼	4¾
20	.097	.152	.219	.298	.39	.49	.61	.73	.87	1.03	1.37	1.75	2.19
21	.102	.159	.229	.312	.41	.52	.64	.77	.92	1.08	1.43	1.84	2.30
22	.107	.167	.240	.327	.43	.54	.67	.81	.96	1.13	1.50	1.93	2.41
23	.112	.175	.251	.342	.45	.57	.70	.84	1.01	1.18	1.57	2.02	2.52
24	.117	.182	.262	.357	.47	.59	.73	.88	1.05	1.23	1.64	2.11	2.63
25	.121	.190	.273	.372	.49	.61	.76	.92	1.09	1.28	1.71	2.19	2.74
26	.126	.197	.284	.387	.51	.64	.79	.96	1.14	1.33	1.78	2.28	2.85
27	.131	.205	.295	.402	.52	.66	.82	.99	1.18	1.39	1.84	2.37	2.96
28	.136	.212	.306	.416	.54	.69	.85	1.03	1.22	1.44	1.91	2.46	3.07
29	.141	.220	.317	.431	.56	.71	.88	1.07	1.27	1.49	1.98	2.54	3.18
30	.146	.228	.328	.446	.58	.74	.91	1.10	1.31	1.54	2.05	2.63	3.29
31	.151	.235	.339	.461	.60	.76	.94	1.14	1.36	1.59	2.12	2.72	3.40
32	.155	.243	.350	.476	.62	.79	.97	1.18	1.40	1.64	2.19	2.81	3.51
33	.160	.250	.361	.491	.64	.81	1.00	1.21	1.44	1.69	2.25	2.90	3.62
34	.165	.258	.372	.506	.66	.84	1.03	1.25	1.49	1.74	2.32	2.98	3.73
35	.170	.266	.382	.521	.68	.86	1.06	1.29	1.53	1.80	2.39	3.07	3.84
36	.175	.273	.393	.536	.70	.89	1.09	1.32	1.57	1.85	2.46	3.16	3.95
37	.180	.281	.404	.550	.72	.91	1.12	1.36	1.62	1.90	2.53	3.25	4.05
38	.185	.288	.415	.565	.74	.93	1.15	1.40	1.66	1.95	2.60	3.33	4.16
39	.189	.296	.426	.580	.76	.96	1.18	1.43	1.70	2.00	2.66	3.42	4.27
40	.194	.304	.437	.595	.78	.98	1.21	1.47	1.75	2.05	2.73	3.51	4.38
41	.199	.311	.448	.610	.80	1.01	1.24	1.51	1.79	2.10	2.80	3.60	4.49
42	.204	.319	.459	.625	.82	1.03	1.27	1.54	1.84	2.15	2.87	3.68	4.60
43	.209	.326	.470	.640	.84	1.06	1.31	1.58	1.88	2.21	2.94	3.77	4.71
44	.214	.334	.481	.654	.85	1.08	1.34	1.62	1.92	2.26	3.01	3.86	4.82
45	.219	.342	.492	.669	.87	1.11	1.37	1.65	1.97	2.31	3.07	3.95	4.93
46	.223	.349	.503	.684	.89	1.13	1.40	1.69	2.01	2.36	3.14	4.04	5.04
47	.228	.357	.514	.699	.91	1.16	1.43	1.73	2.05	2.41	3.21	4.12	5.15
48	.233	.364	.525	.714	.93	1.18	1.46	1.76	2.10	2.46	3.28	4.21	5.26
49	.238	.372	.535	.729	.95	1.20	1.49	1.80	2.14	2.51	3.35	4.30	5.37
50	.243	.379	.546	.744	.97	1.23	1.52	1.84	2.19	2.57	3.42	4.39	5.48
51	.248	.387	.557	.759	.99	1.25	1.55	1.87	2.23	2.62	3.48	4.47	5.59
52	.253	.395	.568	.774	1.01	1.28	1.58	1.91	2.27	2.67	3.55	4.56	5.70
53	.257	.402	.579	.788	1.03	1.30	1.61	1.95	2.32	2.72	3.62	4.65	5.81
54	.262	.410	.590	.803	1.05	1.33	1.64	1.98	2.36	2.77	3.69	4.74	5.92
55	.267	.417	.601	.818	1.07	1.35	1.67	2.02	2.40	2.82	3.76	4.83	6.03
56	.272	.425	.612	.833	1.09	1.38	1.70	2.06	2.45	2.87	3.83	4.91	6.14
57	.277	.433	.623	.848	1.11	1.40	1.73	2.09	2.49	2.92	3.89	5.00	6.25
58	.282	.440	.634	.863	1.13	1.43	1.76	2.13	2.54	2.98	3.96	5.09	6.36
59	.287	.448	.645	.878	1.15	1.45	1.79	2.17	2.58	3.03	4.03	5.18	6.47
60	.291	.455	.656	.892	1.17	1.48	1.82	2.20	2.62	3.08	4.10	5.26	6.58
61	.296	.463	.667	.907	1.19	1.50	1.85	2.24	2.67	3.13	4.17	5.35	6.68
62	.301	.471	.678	.922	1.20	1.52	1.88	2.28	2.71	3.18	4.23	5.44	6.79
63	.306	.478	.688	.937	1.22	1.55	1.91	2.31	2.75	3.23	4.30	5.53	6.90
64	.311	.486	.699	.952	1.24	1.57	1.94	2.35	2.80	3.28	4.37	5.61	7.01
65	.316	.493	.710	.967	1.26	1.60	1.97	2.39	2.84	3.33	4.44	5.70	7.12
66	.321	.501	.721	.982	1.28	1.62	2.00	2.42	2.89	3.39	4.51	5.79	7.23
67	.325	.508	.732	.997	1.30	1.65	2.03	2.46	2.93	3.44	4.58	5.88	7.34
68	.330	.516	.743	1.012	1.32	1.67	2.06	2.50	2.97	3.49	4.64	5.97	7.45
69	.335	.524	.754	1.026	1.34	1.70	2.09	2.53	3.02	3.54	4.71	6.05	7.56
70	.340	.531	.765	1.041	1.36	1.72	2.12	2.57	3.06	3.59	4.78	6.14	7.67
71	.345	.539	.776	1.056	1.38	1.75	2.16	2.61	3.10	3.64	4.85	6.23	7.78
72	.350	.546	.787	1.071	1.40	1.77	2.19	2.64	3.15	3.69	4.92	6.32	7.89
73	.355	.554	.798	1.086	1.42	1.79	2.22	2.68	3.19	3.75	4.99	6.40	8.00
74	.359	.562	.809	1.101	1.44	1.82	2.25	2.72	3.23	3.80	5.05	6.49	8.11
75	.364	.569	.820	1.116	1.46	1.84	2.28	2.75	3.28	3.85	5.12	6.58	8.22
76	.369	.577	.831	1.130	1.48	1.87	2.31	2.79	3.32	3.90	5.19	6.67	8.33
77	.374	.584	.841	1.145	1.50	1.89	2.34	3.83	3.37	3.95	5.26	6.76	8.44
78	.379	.592	.852	1.160	1.52	1.92	2.37	2.87	3.41	4.00	5.33	6.84	8.55
79	.384	.600	.863	1.175	1.53	1.94	2.40	2.90	3.45	4.05	5.40	6.93	8.66
80	.389	.607	.874	1.190	1.55	1.97	2.43	2.94	3.50	4.10	5.46	7.02	8.77
81	.393	.615	.885	1.205	1.57	1.99	2.46	2.98	3.54	4.16	5.53	7.11	8.88
82	.398	.622	.896	1.220	1.59	2.02	2.49	3.01	3.58	4.21	5.60	7.19	8.99
83	.403	.630	.907	1.235	1.61	2.04	2.52	3.05	3.63	4.26	5.67	7.28	9.10
84	.408	.637	.918	1.250	1.63	2.07	2.55	3.09	3.67	4.31	5.74	7.37	9.21
85	.413	.645	.929	1.264	1.65	2.09	2.58	3.12	3.72	4.36	5.81	7.46	9.32
86	.418	.653	.940	1.279	1.67	2.11	2.61	3.16	3.76	4.41	5.87	7.54	9.42
87	.423	.660	.951	1.294	1.69	2.14	2.64	3.20	3.80	4.46	5.94	7.63	9.53
88	.427	.668	.962	1.309	1.71	2.16	2.67	3.23	3.85	4.51	6.01	7.72	9.64
89	.432	.675	.973	1.324	1.73	2.19	2.70	3.27	3.89	4.57	6.08	7.81	9.75
90	.437	.683	.984	1.339	1.75	2.21	2.73	3.31	3.93	4.62	6.15	7.90	9.86

[1]Length of stroke in feet times number of strokes per minute.


WE still SAY, "THERE'S NO ECONOMICAL SUBSTITUTE FOR AXELSON PRODUCTS"
AXELSON
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MANUFACTURERS SINCE 1892
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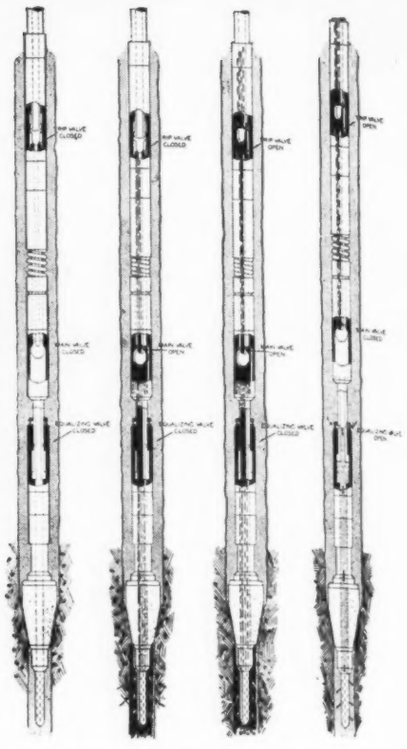
Axelson Manufacturing Company, P. O. Box 710, Vernon Station, Los Angeles • St. Louis • 50 Church Street, New York • Tulsa
Mid-Continent and Eastern Distributor: Frick-Reid Supply Corp. • *Rocky Mountain Distributor:* Great Northern Tool & Supply Co.

DEEP WELL PLUNGER PUMPS **AXELSON** SUCKER RODS

WEIGHT OF DRILL PIPE AND CASING AND VOLUME OF FLUID DISPLACED

Diameter, in.	Weight, lb. per 100 ft.	Volume of fluid displaced per 100 ft., gal.	
		Lower end open	Lower end closed
Drillpipe			
2⅜	480	7.18	23.01
	665	10.16	
2⅞	645	9.86	33.72
	835	12.76	
	1,040	15.89	
3½	850	12.99	49.98
	1,120	17.12	
	1,330	20.32	
4½	1,275	19.48	82.62
	1,375	21.01	
	1,660	25.37	
5⅝	1,900	29.03	126.26
	2,220	33.92	
	2,525	38.58	
6⅝	2,220	33.92	179.07
	2,520	38.51	
	3,190	48.75	
Casing			
4¾	1,600	24.45	92.06
5	1,300	19.86	102.00
	1,500	22.92	
	1,800	27.51	
	2,100	32.09	
5½	1,400	21.39	123.42
	1,700	25.98	
	2,000	30.56	
5¾	1,400	21.39	134.90
	1,700	25.98	
	1,950	29.80	
	2,250	34.38	
6	2,000	30.56	146.89
6⅝	2,000	30.56	179.07
	2,200	33.62	
	2,400	36.67	
	2,600	39.73	
	2,800	42.79	
7	1,700	25.98	199.92
	2,000	30.56	
	2,200	33.62	
	2,400	36.67	
	2,600	39.73	
	2,800	42.79	
	3,000	45.84	
	4,300	65.71	
7⅝	2,640	40.34	237.21
	2,970	45.38	
	3,370	51.50	
8	2,600	39.73	261.12
8⅝	2,800	42.79	303.51
	3,200	48.90	
	3,600	55.01	
	3,800	58.07	
	4,300	65.71	
9	3,400	51.96	330.48
	3,800	58.07	
	4,000	61.12	
	4,500	68.76	
9⅝	3,600	55.01	377.97
	3,800	58.07	
	4,000	61.12	
	4,200	64.18	
	4,350	66.47	
10	3,300	50.43	408.00
10¾	4,050	61.89	471.50
	4,550	69.53	
	5,100	77.93	
	5,550	84.81	
11¾	4,700	71.82	563.30
	5,400	82.52	
	6,000	91.68	
12	4,000	61.12	587.52
13	4,000	61.12	689.52
	4,500	68.76	
	5,000	76.40	
	5,400	82.52	
13⅜	4,800	73.35	729.87
	5,450	83.28	
	6,100	93.21	
	6,800	103.91	
14	5,000	76.40	799.68
16	5,500	84.04	1,044.48
	6,500	99.33	
	7,000	106.97	
	7,500	114.61	
	8,400	128.36	
18⅝	7,800	119.19	1,415.31
	8,750	133.71	
	9,650	147.46	
20	9,000	137.53	1,632.00
21½	9,250	141.35	1,885.98
	10,300	157.39	
	11,400	174.20	
24½	10,050	153.57	2,449.02
	11,300	172.67	



The Johnston Formation Tester is the Super Sleuth of the Underworld—giving you inside information on the private life of each oil zone in your well. With it you KNOW which are high pressure formations, which are low pressure—which are wet, which are dry . . . and with this information you forge ahead, intelligently and confidently mapping out the entire future of your well.

Without setting casing the Johnston tests the well through the drill pipe under actual producing conditions, and traps samples of the formation fluid to be brought to the surface for close observation and test. The four important steps in making a Johnston test are shown on the right . . . study these and note how the tester operates without risky twisting or turning of the drill string . . . and without imposing dangerous strains on your rig or equipment!

An engineering brochure has been prepared showing the various Johnston Valves in detail and outlining their methods of operation, together with a general description of the applications and operating methods of the entire testing tool. Write for it today . . . it's free!

A JOHNSTON TEST IN FOUR SIMPLE STEPS

● This first step shows the tester just after the packer has seated, but before any of the valves have opened. The closed Trip and Main Valves have served as a DOUBLE SEAL in keeping the drill pipe dry while running in the hole, and note in succeeding steps how simply and positively they open when the proper time comes.

● The Main (or Retaining) Valve opens first as the weight of the drill pipe lowered against the packer compresses the spring that has held it shut. This allows formation fluid to enter as far as the closed Trip Valve.

● The patented Trip Valve then opens by the impact of a go-devil dropped through the pipe (but if any leaks have let fluid into the pipe from above, the Trip Valve doesn't open—an exclusive safety precaution that prevents confusing pipe leaks with actual formation tests). With the Trip Valve open and the mud pressure held back by the packer, the formation is free to flow through the pipe under actual producing conditions.

● With the test completed a mere lifting of the drill string allows the compressed spring to close the Main Valve, trapping formation fluid in the pipe to be brought to the surface for close observation and test. Continued lifting of the pipe opens the patented Equalizing Valve which allows fluid from above the packer to enter the test section, equalizing the pressure and relieving the tremendous weight of the mud column before the packer is lifted from the seat. This vital safety device eliminates the enormous strain on rig and equipment of pulling the packer loose against the hydrostatic pressure of the mud column, and the M. O. Johnston Oil Field Service Corporation is the SOLE LICENSEE PERMITTED TO USE IT!

WHY SET CASING BEFORE YOU KNOW?

DISPLACEMENT OF RECIPROCATING PUMPS, GAL. PER STROKE

Cylinder diameter, in.	Length of stroke, in.									
	4	5	6	7	8	9	10	11	12	13
Double-acting factor[1]	.0136	.0170	.0204	.0238	.0272	.0306	.0340	.0374	.0408	.0442
2	.054	.068	.082	.095	.109	.122	.136	.150	.163	.177
2¼	.069	.086	.103	.121	.138	.155	.172	.189	.206	.224
2½	.085	.106	.128	.149	.170	.191	.212	.234	.255	.276
2¾	.103	.129	.154	.180	.206	.231	.259	.283	.309	.334
3	.122	.153	.184	.214	.245	.275	.306	.337	.367	.398
3¼	.144	.180	.215	.251	.287	.323	.359	.395	.431	.467
3½	.167	.208	.250	.292	.333	.375	.417	.458	.500	.541
3¾	.191	.239	.287	.335	.382	.430	.478	.526	.574	.622
4	.218	.272	.326	.381	.435	.490	.544	.598	.653	.708
4¼	.246	.307	.368	.430	.491	.553	.614	.676	.736	.798
4½	.275	.344	.413	.482	.550	.620	.689	.757	.826	.895
4¾	.307	.384	.460	.537	.614	.690	.768	.844	.920	.997
5	.340	.425	.510	.595	.680	.765	.850	.935	1.020	1.105
5¼	.375	.469	.562	.656	.750	.843	.938	1.031	1.124	1.218
5½	.411	.514	.617	.720	.822	.926	1.028	1.131	1.234	1.337
5¾	.450	.562	.674	.787	.900	1.012	1.124	1.237	1.348	1.461
6	.490	.612	.734	.857	.980	1.102	1.224	1.346	1.468	1.591
6½	.575	.718	.862	1.006	1.150	1.293	1.436	1.580	1.724	1.867
7	.666	.833	1.000	1.166	1.332	1.499	1.666	1.833	2.000	2.166
7½	.765	.956	1.148	1.339	1.530	1.721	1.912	2.104	2.296	2.487
8	.870	1.088	1.306	1.523	1.740	1.958	2.176	2.394	2.612	2.829
8½	.983	1.228	1.474	1.719	1.965	2.211	2.456	2.702	2.948	3.193
9	1.102	1.377	1.652	1.928	2.204	2.479	2.754	3.029	3.304	3.580
9½	1.227	1.534	1.841	2.148	2.454	2.762	3.068	3.375	3.682	3.989
10	1.360	1.700	2.040	2.380	2.720	3.060	3.400	3.740	4.080	4.420
10½	1.500	1.875	2.250	2.625	3.000	3.375	3.750	4.123	4.500	4.875
11	1.646	2.057	2.468	2.880	3.292	3.703	4.114	4.525	4.936	5.348
11½	1.798	2.248	2.698	3.147	3.596	4.046	4.496	4.946	5.396	5.845
12	1.958	2.448	2.938	3.427	3.916	4.406	4.896	5.386	5.876	6.365
12½	2.124	2.655	3.186	3.717	4.248	4.779	5.310	5.844	6.372	6.903
13	2.298	2.873	3.447	4.022	4.597	5.171	5.746	6.321	6.895	7.469
13½	2.478	3.095	3.714	4.335	4.952	5.571	6.190	6.816	7.428	8.049
14	2.666	3.332	3.998	4.665	5.331	5.998	6.664	7.330	7.997	8.663
14½	2.859	3.574	4.289	5.004	5.719	6.433	7.148	7.863	8.578	9.283
15	3.060	3.825	4.590	5.355	6.120	6.885	7.650	8.415	9.180	9.945
15½	3.264	4.080	4.896	5.712	6.528	7.344	8.160	8.985	9.792	10.608
16	3.481	4.352	5.222	6.093	6.963	7.833	8.704	9.574	10.444	11.315
16½	3.700	4.625	5.550	6.475	7.400	8.325	9.250	10.182	11.100	12.025
17	3.932	4.915	5.898	6.881	7.864	8.847	9.830	10.809	11.796	12.779
17½	4.164	5.205	6.246	7.287	8.328	9.369	10.410	11.454	12.492	13.533
18	4.406	5.508	6.610	7.711	8.813	9.914	11.016	12.118	13.219	14.321
18½	4.656	5.820	6.984	8.148	9.312	10.476	11.640	12.800	13.968	15.132
19	4.910	6.137	7.364	8.592	9.819	11.047	12.274	13.501	14.729	15.956
20	5.440	6.800	8.160	9.520	10.880	12.240	13.600	14.960	16.320	17.680
22	6.582	8.227	9.872	11.518	13.164	14.808	14.454	18.102	19.744	21.390
24	7.832	9.791	11.750	13.707	15.664	17.625	19.582	21.542	23.500	25.457

[1]For double-acting pumps deduct the product of this factor, times the square of the rod diameter in inches, from twice the figure obtained from the body of the table.

SPECIALISTS 20 YEARS
in Pipe Line Pumps

Fig. 601. GASO Walking Beam Pump—30.30 to 55.10 Bbls. per Hr.

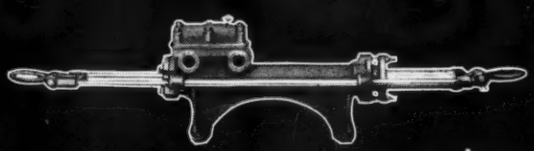


Fig. 201. GASO Rodline Pump — 30.96 to 41.28 Bbls. per Hr.

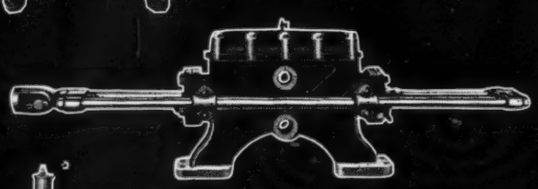


Fig. 301. GASO Piston Power Pump—31.73 to 157.36 Bbls. per Hr.

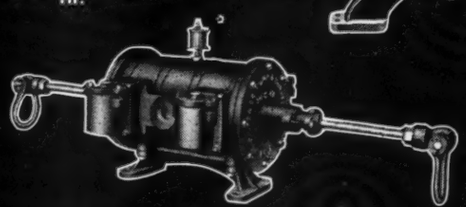


Fig. 604½. GASO Rodline Pump for Gas or Vacuum—26-28 Points Vacuum

Fig. 604. GASO Walking Beam Pump, Gas or Vacuum — 26-28 Pts. Vac.

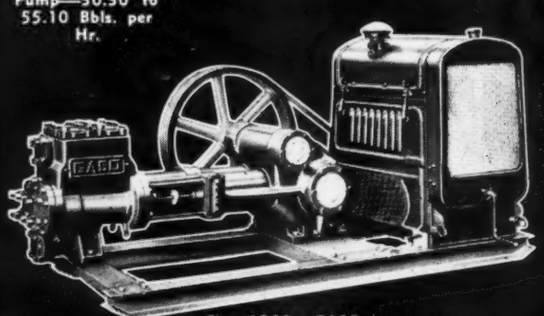


Fig. 1844. GASO Duplex Piston Pump 50 to 288 Bbls. per Hr.

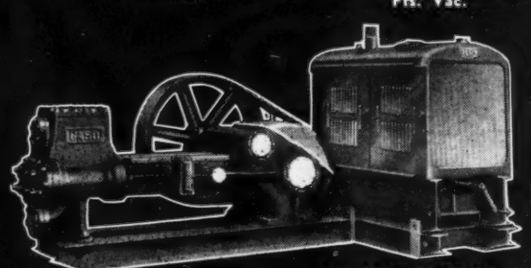


Fig. 1740. GASO Duplex Piston Pump — Gasoline Engine Drive, 54 to 250 Bbls. per Hr.

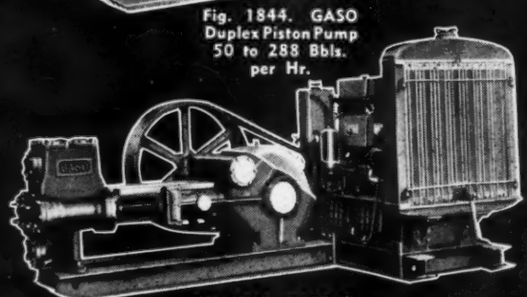


Fig. 1741. GASO Duplex Piston Pump — Diesel Engine Drive—54 to 502 Bbls. per Hr.

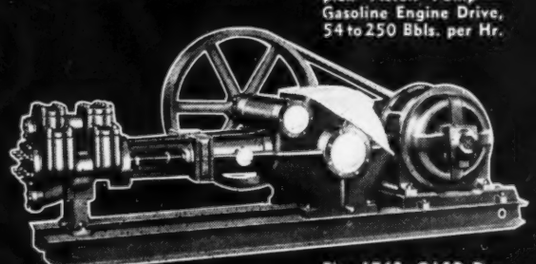


Fig. 1742. GASO Duplex Piston Pump — Electric Drive—54 to 250 Bbls. per Hr.

See GASO Section, 1937 Composite Catalog, or Send for Complete Catalog

GASO PUMP & BURNER MFG. CO., Tulsa, Okla.
Export Office: 149 Broadway, New York

GASO PUMPS

DISPLACEMENT OF RECIPROCATING PUMPS, GAL. PER STROKE

Cylinder diameter, in.	Length of stroke, in.									
	14	15	16	18	20	22	24	26	30	36
Double-acting factor[1]	.0476	.0510	.0544	.0612	.0680	.0748	.0816	.0884	.1020	.1224
4	.762	.816	.870	.979	1.088	1.197	1.306	1.414	1.632	1.958
4¼	.860	.921	.982	1.105	1.228	1.351	1.472	1.597	1.842	2.211
4½	.964	1.033	1.100	1.239	1.377	1.515	1.652	1.790	2.066	2.479
4¾	1.074	1.150	1.228	1.381	1.534	1.688	1.840	1.995	2.301	2.761
5	1.190	1.275	1.360	1.530	1.700	1.870	2.040	2.210	2.550	3.060
5¼	1.312	1.405	1.500	1.687	1.874	2.062	2.248	2.437	2.811	3.374
5½	1.440	1.543	1.644	1.852	2.057	2.263	2.468	2.674	3.086	3.703
5¾	1.574	1.686	1.800	2.023	2.248	2.473	2.696	2.923	3.372	4.047
6	1.714	1.836	1.960	2.203	2.448	2.693	2.936	3.182	3.672	4.406
6¼	1.860	1.992	2.124	2.390	2.656	2.922	3.188	3.453	3.984	4.781
6½	2.012	2.155	2.300	2.585	2.873	3.160	3.448	3.735	4.310	5.171
6¾	2.168	2.324	2.480	2.788	3.098	3.408	3.716	4.028	4.647	5.576
7	2.332	2.499	2.664	2.999	3.332	3.665	4.000	4.332	4.998	5.998
7¼	2.502	2.681	2.859	3.217	3.574	3.932	4.289	4.647	5.361	6.434
7½	2.678	2.869	3.060	3.443	3.825	4.208	4.592	4.973	5.738	6.885
7¾	2.858	3.063	3.267	3.676	4.084	4.493	4.900	5.310	6.126	7.351
8	3.046	3.264	3.480	3.917	4.352	4.787	5.224	5.658	6.528	7.834
8¼	3.240	3.471	3.703	4.165	4.628	5.091	5.554	6.017	6.942	8.331
8½	3.438	3.684	3.930	4.421	4.912	5.404	5.896	6.387	7.370	8.843
8¾	3.644	3.904	4.164	4.685	5.206	5.727	6.248	6.768	7.809	9.371
9	3.856	4.131	4.408	4.957	5.508	6.059	6.608	7.160	8.262	9.914
9¼	4.073	4.364	4.655	5.236	5.818	6.400	6.982	7.564	8.727	10.473
9½	4.296	4.603	4.908	5.523	6.137	6.751	7.364	7.978	9.206	11.046
10	4.760	5.100	5.440	6.120	6.800	7.480	8.160	8.840	10.200	12.240
10½	5.250	5.625	6.000	6.750	7.500	8.247	9.000	9.746	11.246	13.500
11	5.760	6.171	6.584	7.405	8.228	9.051	9.872	10.696	12.342	14.810
11½	6.294	6.744	7.192	8.093	8.992	9.892	10.792	11.691	13.490	16.186
12	6.854	7.344	7.832	8.813	9.792	10.771	11.752	12.730	14.688	17.626
12½	7.434	7.965	8.496	9.558	10.620	11.688	12.744	13.813	15.938	19.116
13	8.044	8.619	9.194	10.342	11.492	12.641	13.790	14.940	17.238	20.684
13½	8.666	9.285	9.904	11.142	12.380	13.632	14.856	16.111	18.590	22.284
14	9.330	9.994	10.662	11.995	13.328	14.661	15.994	17.326	19.992	23.990
14½	10.008	10.722	11.438	12.867	14.296	15.727	17.156	18.586	21.446	25.734
15	10.710	11.475	12.240	13.770	15.300	16.830	18.360	19.890	22.950	27.540
15½	11.424	12.240	13.056	14.688	16.320	17.971	19.584	21.238	24.506	29.376
16	12.186	13.054	13.926	15.665	17.407	19.149	20.888	22.630	26.112	31.332
16½	12.950	13.875	14.800	16.650	18.500	20.364	22.200	24.067	27.770	33.300
17	13.762	14.746	15.728	17.694	19.660	21.617	23.592	25.548	29.478	35.388
17½	14.574	15.615	16.656	18.738	20.820	22.908	24.984	27.073	31.238	37.476
18	15.422	16.524	17.626	19.828	22.032	24.235	26.438	28.642	33.048	39.656
18½	16.296	17.460	18.624	20.952	23.280	25.600	27.936	30.255	34.910	41.904
19	17.184	18.410	19.638	22.093	24.548	27.003	29.458	31.912	36.822	44.186
19½	18.102	19.395	20.688	23.274	25.860	28.443	31.032	33.614	38.786	46.548
20	19.040	20.400	21.760	24.480	27.200	29.920	32.640	35.360	40.800	48.960
22	23.036	24.680	26.328	29.620	32.910	36.203	39.488	42.786	49.368	59.240
24	27.414	29.370	31.328	35.250	39.160	43.085	47.000	50.918	58.752	70.500

[1]For double-acting pumps deduct the product of this factor, times the square of the rod diameter in inches, from twice the figure obtained from the body of the table.

SPECIALISTS 20 YEARS
in Pipe Line Pumps

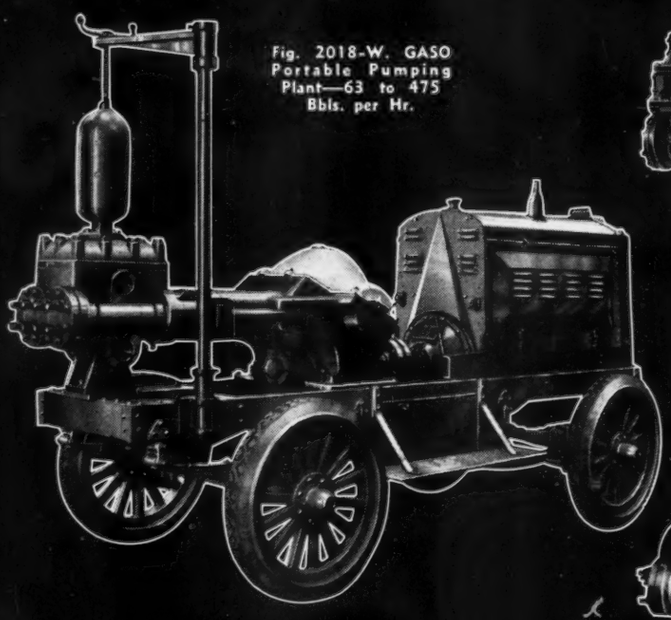


Fig. 2018-W. GASO Portable Pumping Plant—63 to 475 Bbls. per Hr.

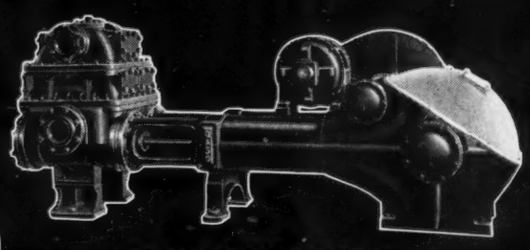


Fig. 1931. GASO Duplex Piston Suction Pump—377 to 1045 Bbls. per Hr.

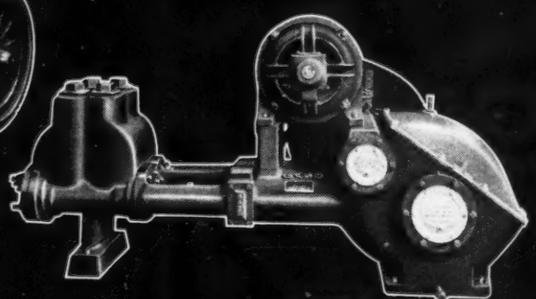


Fig. 1509. GASO Duplex Piston Pump—63 to 250 Bbls. per Hr.

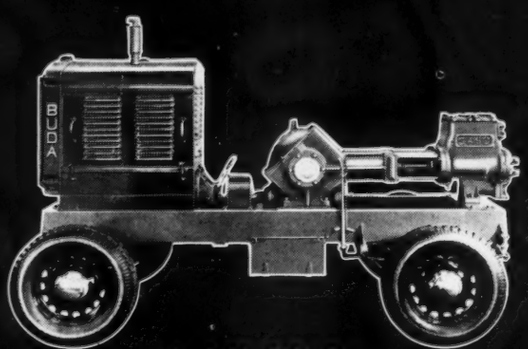


Fig. 2244. GASO Portable Pumping Plant on Trailer—50 to 128 Bbls. per Hr.

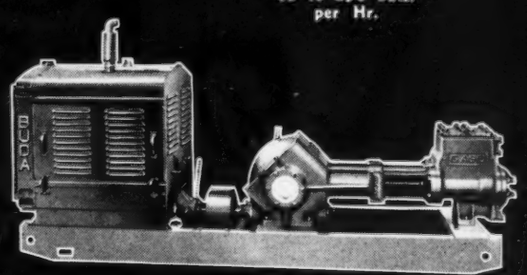


Fig. 2244. GASO Portable Pumping Plant on Skids—50 to 128 Bbls. per Hr.

See GASO Section, 1937 Composite Catalog, or Send for Complete Catalog

GASO PUMP & BURNER MFG. CO., Tulsa, Okla.
Export Office: 149 Broadway, New York

GASO PUMPS

HEAT LOSS FROM UNINSULATED 2-in. STEAM LINE, THOUSAND B.t.u. PER HR.[1]

Length of line, ft.	Temperature difference between steam and air, deg. fahr.										
	100	125	150	175	200	225	250	275	300	325	350
20	2.85	3.63	4.61	5.68	6.81	8.06	9.36	10.8	12.2	13.8	15.5
30	4.27	5.45	6.91	8.52	10.2	12.1	14.0	16.2	18.4	20.7	23.2
40	5.70	7.27	9.21	11.4	13.6	16.1	18.7	21.6	24.5	27.7	30.9
50	7.12	9.09	11.5	14.2	17.0	20.1	23.4	26.9	30.6	34.6	38.7
60	8.55	10.9	13.8	17.0	20.4	24.2	28.1	32.3	36.7	41.5	46.4
70	9.97	12.7	16.1	19.9	23.9	28.2	32.8	37.7	42.9	48.4	54.1
80	11.4	14.5	18.4	22.7	27.3	32.2	37.4	43.1	49.0	55.3	61.9
90	12.8	16.4	20.7	25.6	30.7	36.3	42.1	48.5	55.1	62.2	69.6
100	14.2	18.2	23.0	28.4	34.1	40.3	46.8	53.9	61.2	69.2	77.3
110	15.7	20.0	25.3	31.2	37.5	44.3	51.5	59.3	67.4	76.1	85.1
120	17.1	21.8	27.6	34.1	40.9	48.4	56.2	64.7	73.5	83.0	92.8
130	18.5	23.6	29.9	36.9	44.3	52.4	60.8	70.1	79.6	89.9	101
140	19.9	25.4	32.2	39.7	47.7	56.4	65.5	75.4	85.7	96.8	108
150	21.4	27.3	34.5	42.6	51.1	60.4	70.2	80.8	91.8	104	116
160	22.8	29.1	36.8	45.4	54.5	64.5	74.9	86.2	98.0	111	124
170	24.2	30.9	39.1	48.3	57.9	68.5	79.6	91.6	104	118	131
180	25.6	32.7	41.4	51.1	61.3	72.5	84.3	97.0	110	124	139
190	27.1	34.5	43.7	53.9	64.7	76.6	88.9	102	116	131	147
200	28.5	36.3	46.1	56.8	68.1	80.6	93.6	108	122	138	155
210	29.9	38.2	48.4	59.6	71.6	84.6	98.3	113	129	145	162
220	31.3	40.0	50.7	62.5	75.0	88.6	103	119	135	152	170
230	32.8	41.8	53.0	65.3	78.4	92.7	108	124	141	159	178
240	34.2	43.6	55.3	68.1	81.8	96.7	112	129	147	166	186
250	35.6	45.4	57.6	71.0	85.2	101	117	135	153	173	193
260	37.0	47.2	59.9	73.8	88.6	105	122	140	159	180	201
270	38.5	49.1	62.2	76.7	92.0	109	126	145	165	187	209
280	39.9	50.9	64.5	79.5	95.4	113	131	151	171	194	217
290	41.3	52.7	66.8	82.3	98.8	117	136	156	178	201	224
300	42.7	54.5	69.1	85.2	102	121	140	162	184	207	232
310	44.2	56.3	71.4	88.0	106	125	145	167	190	214	240
320	45.6	58.1	73.7	90.8	109	129	150	172	196	221	247
330	47.0	60.0	76.0	93.7	112	133	154	178	202	228	255
340	48.4	61.8	78.3	96.5	116	137	159	183	208	235	263
350	49.9	63.6	80.6	99.4	119	141	164	189	214	242	271
360	51.3	65.4	82.9	102	123	145	169	194	220	249	278
370	52.7	67.2	85.2	105	126	149	173	199	227	256	286
380	54.1	60.9	87.5	108	129	153	178	205	233	263	294

[1]A heat loss of 1000 B.t.u. per hour indicates a fuel waste of approximately 1⅓ cu. ft. of gas per hour, or 32 cu. ft. per 24 hour day.

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LONG BEACH CALIFORNIA

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VISCOSITY INDEX[1] OF OIL

Viscosity at 100° fahr., Saybolt Universal seconds	Viscosity at 210° fahr., Saybolt Universal seconds																	
	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120	125	130	135	140
400	15	75																	
500		36	79																
600		0	51	81															
700			23	59	83	99													
800				37	66	85	99												
900				16	48	70	87	98											
1000					31	56	75	88	98										
1100					14	41	63	78	90	99									
1200						27	51	68	81	91	99								
1300						12	39	58	73	83	92	99							
1400							27	48	64	75	85	93	100						
1500							15	37	55	68	78	87	94						
1600							3	27	46	60	72	81	89	95					
1700								17	37	52	65	75	84	90	96				
1800								6	28	44	58	69	78	85	92	97			
1900									19	36	51	63	72	80	87	93	98		
2000									10	28	44	56	67	75	83	89	94	99	
2100									1	20	37	50	61	70	78	85	91	95	100
2200										13	30	44	56	65	74	81	87	92	96
2300										5	24	38	51	61	69	77	83	89	93
2400											17	32	45	56	65	73	79	85	90
2600											3	20	34	46	56	64	72	78	83
2800												7	23	36	47	56	64	71	77
3000													12	26	38	48	57	64	71
3200													1	16	29	40	49	57	64
3400														6	20	31	42	50	58
3600															11	23	34	43	51
3800															2	15	26	36	45
4000																7	19	29	38
4200																	11	22	32
4400																	4	15	26
4600																		8	20
4800																		2	13

[1]Because this is an arbitrary scale, oils may be found to have a viscosity index less than 0 or greater than 100.

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Measurement and control of Gas, Oil, Steam, Air and Liquids
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